CREATIVE

PROGRAMMING

John Doty

M-Th 2:30-7:30

TRS-80® VOL I

CREATIVE

Programming Inc.

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CREATIVE PROGRAMMING

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Your computer, the TRS-80 Model III™ is great fun to use and will help you in many, many ways. All it asks is for you to tell it what to do.

GIVING THE COMPUTER INSTRUCTIONS IS CALLED PROGRAMMING.

To program the computer, you will have to learn its language. Not all computers use the same language. In this book you will learn the most popular of all computer languages — BASIC. It is not only the language that is used the most, but it is also easier to learn than any foreign language.

THE COMPUTER LANGUAGE YOU ARE LEARNING IS BASIC.

The words in BASIC are called commands. In each lesson in this book you will learn a new command.

The lesson explains what the command (word) means and shows you how to use it.

Just as words create a sentence, a series of commands creates a computer program.

By knowing just a few words, you will be able to ask your computer to solve problems. And, of course, the fun really begins when you learn more words. Then, you will find all the wonderful things a computer can do. It will amaze and delight you.

Let's start now . . .

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TURNING ON THE TRS-80 MODEL III™ WITH CASSETTE TAPE PLAYER.

1. To get acquainted with your computer friend, you must awaken it. All you have to do is find the power switch under the right side of the computer and turn it on. See Figure 1.

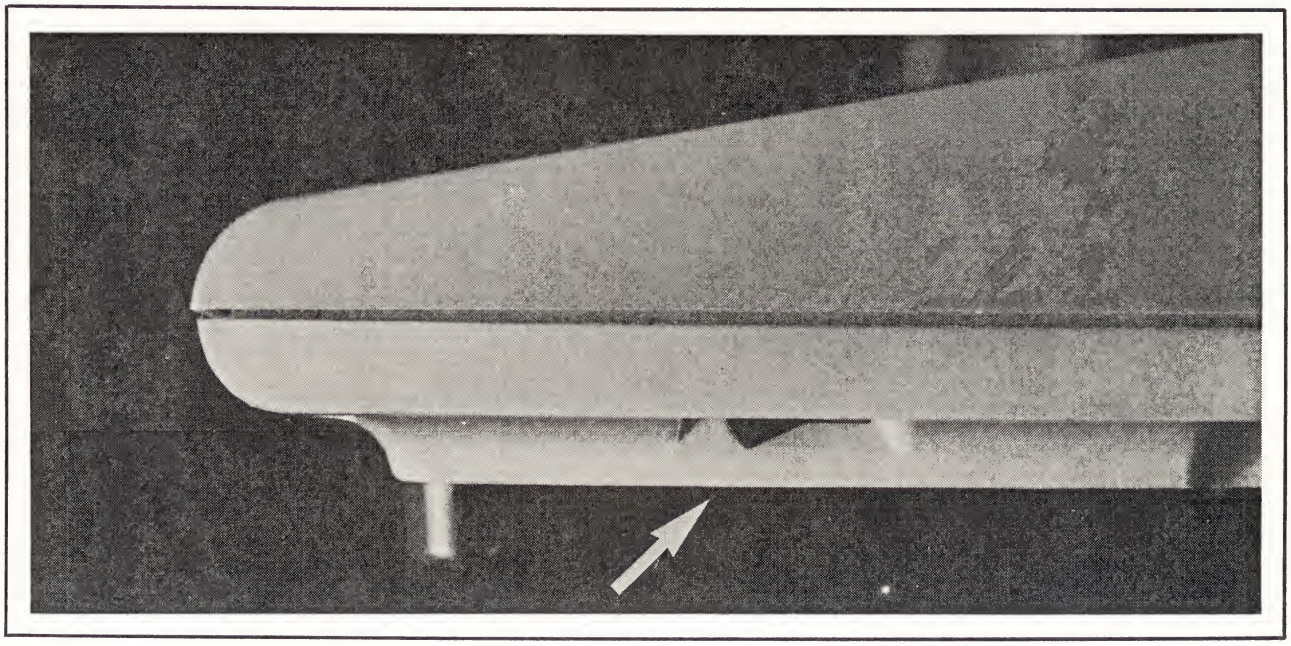

Figure 1

You'll know your friend's awake when you see . . .

Cass?

on the screen. (Cass stands for Cassette Recorder.) Later on, you'll learn how to answer your computer's question. But for the moment, just press the . . .

2. ENTER key. (Either one will do, but let's use the double-width white one that is on the third row of keys from the screen and opposite the righthand edge of the screen.) See Figure 2.

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Figure 2

The computer now asks . . .

Memory?

And it's another question that you don't want to answer now, so press ENTER again.

3. Now your screen will look like this:

```
Cass?
Memory?
Radio Shack Model III Basic
© '80 Tandy
READY
>
□
```

That little mark shaped like a boomerang is called a prompt, and the blinking square beneath it is called the cursor (it doesn't swear, that's just its name!) The prompt shows you which line the computer is thinking about and the cursor shows you the position on the line it is thinking about. To make it pay attention to something else — another point on the screen — requires pressing certain keys.

TURNING ON THE RADIO SHACK TRS-80 MODEL III™ WITH DISK DRIVE:

1. Check to be sure that there is no disk in disk drive. Disks should not be in the disk drive when you turn on the computer or when you turn it off.
2. Turn on the computer.
3. Wait for the light on the disk drives to go out and for the motor to stop. The light should be off and the motor stopped before you put a disk into the drive or take one out. Make sure that the label side of the disk is facing upward. Now place the disk in the bottom drive.
4. Press the orange RESET key.

This will appear on the computer's screen . . .

(MM/DD/YY)?

5. It wants to know the month, day and year so that it will be able to identify your material later. Answer by typing in, for example . . .

09/10/83

(For the months January through September, you must put a zero before the number of the month because computers passionately believe that all months have two numbers.) Press ENTER.

6. Being very curious and exacting, the computer will now ask . . .

(HH:MM:SS)?

It wants to know the hour, minute and second. Well, it doesn't need to know that, so press ENTER.

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TURNING ON TRS-80 MODEL III™ WITH DISK DRIVE — continued:

7. The computer will announce . . .

TRSDOS READY

8. The computer needs to know the language in which you'll be giving it instructions. Type in:

BASIC

press
ENTER.

9. The computer will ask more questions:

How many files?

and . . . Memory size?

Just tell it that it doesn't need to know by replying ENTER to each of those questions.

10. Now it should finally say . . .

READY

and beneath that word will be your two helpers:

the prompt . . . >

and the cursor . . . □

That little mark shaped > is called a prompt, and the blinking square beneath it is called the cursor (it doesn't swear — that's just its name). The prompt shows you which line the computer is thinking about and the cursor shows you the position on the line it is thinking about. To make it pay attention to something else — another point on the screen — requires pressing certain keys.

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SPECIAL CHARACTERS AND KEYS

SHIFT

SHIFT tells the computer, "Think of the upstairs row on the Keyboard." SHIFT keys are so important that there are two of them. One is at each end of the row of the keys closest to you. It doesn't make any difference which one you use — whichever is easier. See Figure 3.

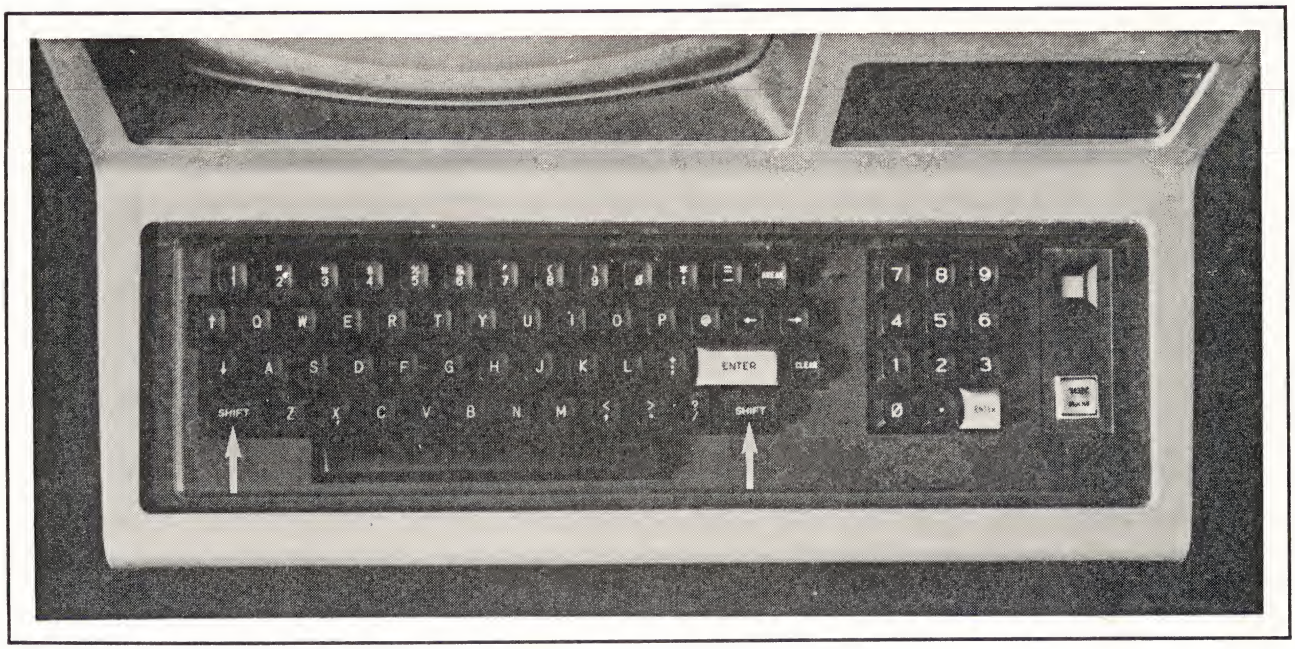

Figure 3

To use the SHIFT key, you must hold the shift key down while you press the other key you want. With quotation marks " " the "downstairs" portion or level is the number 2. Quotation marks are upstairs. See Figure 4.

You need the SHIFT key to make quotation marks " ". They are very important because they tell the computer to write the words between the first quote and the last quote on the screen.

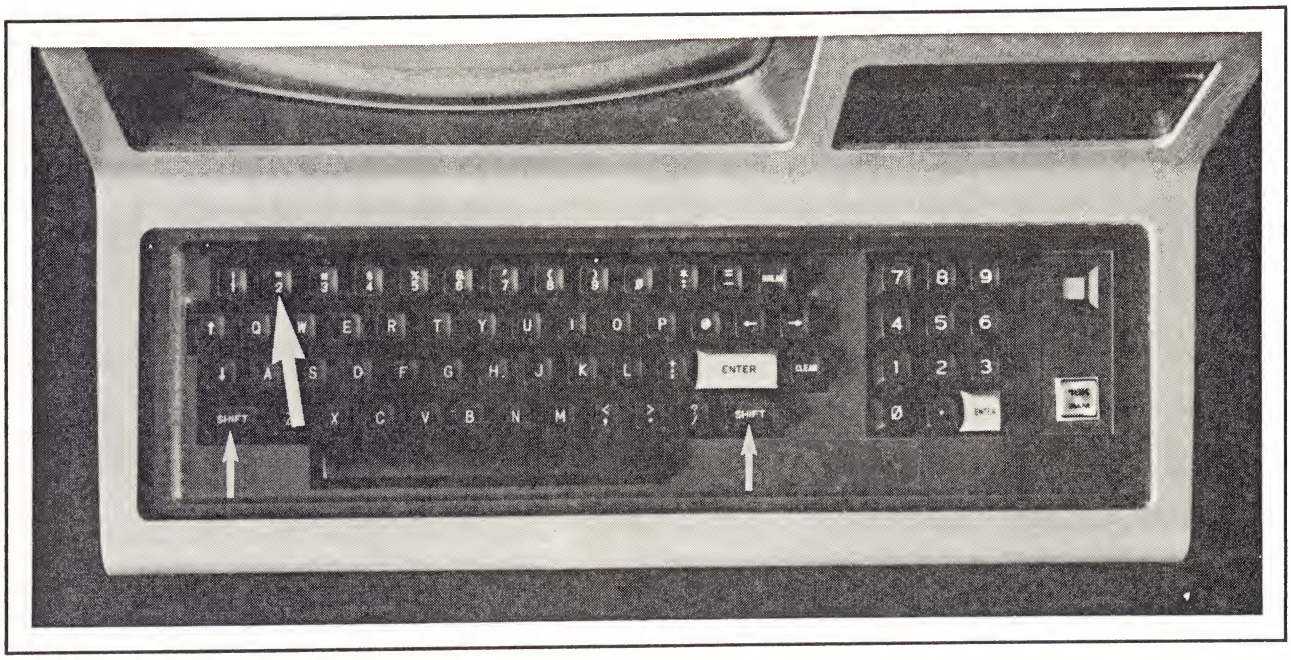

Figure 4

ENTER

When you type a command, it is as if you were writing a note to the computer — the letters appear on the screen, but the computer can't read what you've written until you deliver the note. To deliver it you press ENTER. Only then does the computer do what you've told it to do. See Figure 5.

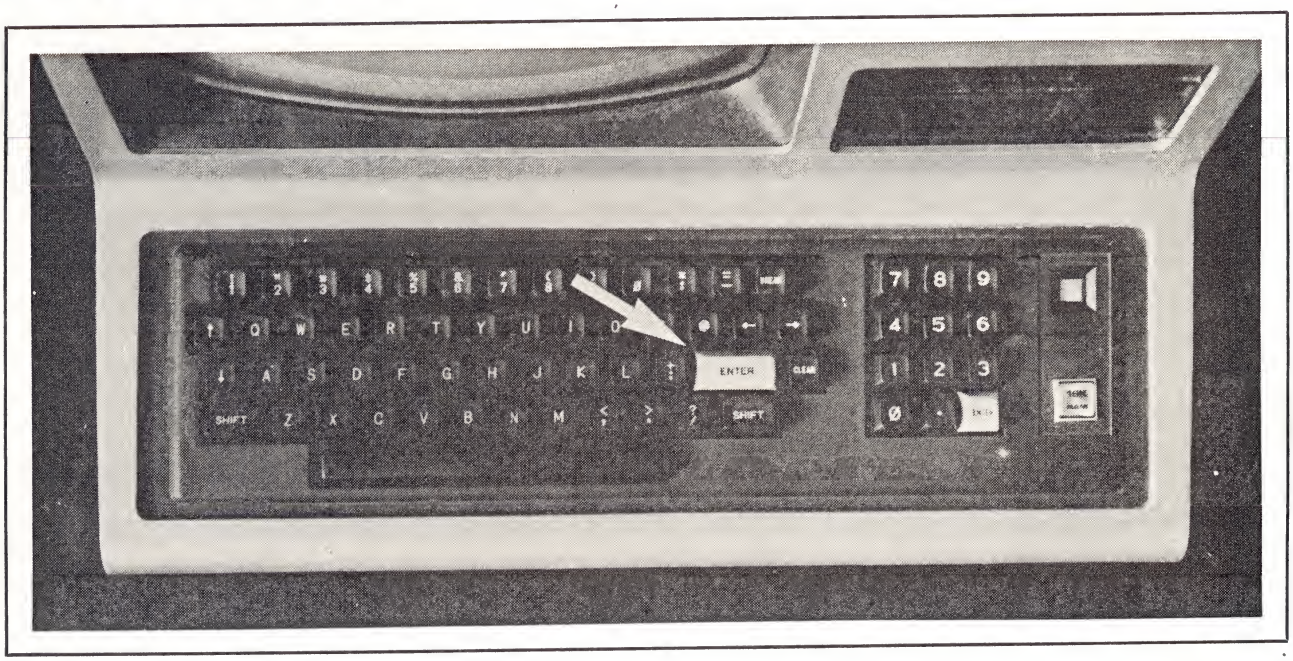

Figure 5

**THE ENTER KEY SENDS
YOUR COMMAND TO THE COMPUTER.**

REMEMBER — the computer can't read your commands until you press ENTER.

SPACE BAR

Sounds as though it would be somewhere an astronaut might go to get soda pop, but not ours — press the long bar closest to you (the only one of the keyboard not labeled), and it puts spaces between letters, words, numbers and symbols. See Figure 6.

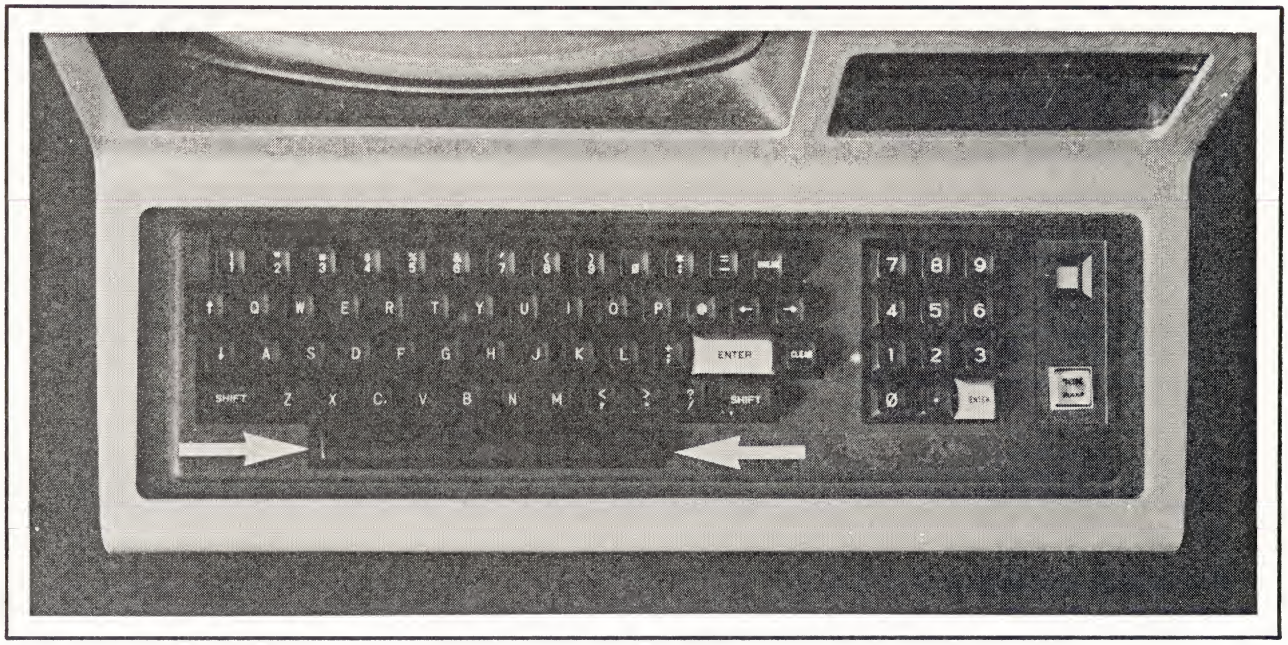

Figure 6

BACK SPACE KEY

The BACK SPACE key is very helpful because fingers don't always type what you want them to type. If that happens — and it will, occasionally — just press the BACK SPACE key and go back to the place where you made your mistake and

type in the correct letters. (But you have to do it before you press the ENTER key . . . or it becomes a little more complicated.) See Figure 7.

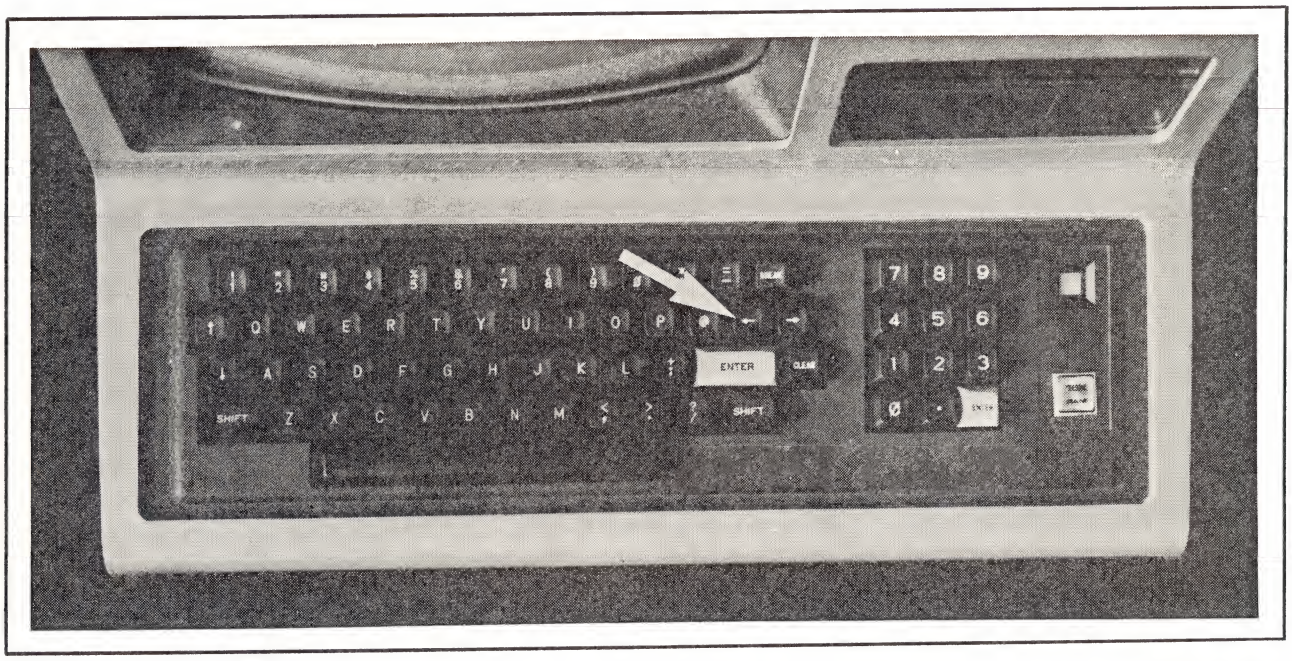

Figure 7

LESSON 1-B — YOUR FIRST PROGRAM

In this lesson you are going to begin to program your computer. You will give it a list of things to do in the order they should be done.

You must give each line a number. With most lists, you would number the things you want done 1, 2, 3, 4 and so on. In giving your computer a list of things to do, though, it works out better to number the lines by tens — 10, 20, 30 and so on. Then you will have blank lines to add in other commands, and everything will still be in the right order.

REMEMBER: NUMBER EVERY LINE OF YOUR PROGRAM. IT IS BEST TO NUMBER THE LINES BY TENS — 10, 20, 30, ETC.)

FIRST COMMAND

The first command you are going to learn is the PRINT command. PRINT tells the computer to print the words you tell it to print on the screen. It's important to remember that the computer will only print words between two sets of quotation marks.

REMEMBER HOW TO TYPE QUOTATION MARKS?
RIGHT — TELL THE COMPUTER "THINK UPSTAIRS"
BY PRESSING THE SHIFT KEY AND
THE 2 KEY AT THE SAME TIME.

All set? Let's program. Type the following line exactly as it is shown:

```
10 PRINT "HAPPY BIRTHDAY"
```

(If you are an experienced typist, you may have a funny feeling over the fact that the computer only knows CAPITAL letters, but you'll get used to it.)

Press the ENTER key.

Did the computer understand your instructions? To find out, type RUN and press the ENTER key.

RUN TELLS THE COMPUTER TO
FOLLOW YOUR INSTRUCTIONS.

RUN is a computer command, but it is not included in your program so it is not given a numbered line. When a command is in your program, it is called a PROGRAM COMMAND. When it is not in your program, it is called a DIRECT COMMAND.

PROGRAM COMMANDS HAVE LINE NUMBERS:
10 PRINT
DIRECT COMMANDS DO NOT NEED A
LINE NUMBER, AS . . .
RUN

Back to the program. If everything was correct, you should now see as the last two lines on your screen . . .

HAPPY BIRTHDAY
READY

Let's get fancier!
Type . . .

20 PRINT "TO EVERYONE"

ENTER and RUN
And now your screen should say . . .

HAPPY BIRTHDAY
TO EVERYONE
READY

as the last three lines.
LET'S TAKE A LOOK AT THE INSTRUCTIONS YOU'VE GIVEN YOUR COMPUTER. To do that, you ask it to show you its LIST. Type that word and ENTER.
Now the three lines at the bottom of your screen will read:

10 PRINT "HAPPY BIRTHDAY"
20 PRINT "TO EVERYONE"
READY

Whenever you want to see the program you have written, type in LIST (and, of course, press ENTER).

LIST IS A DIRECT COMMAND THAT SHOWS YOU THE PROGRAM YOU HAVE WRITTEN.

Okay, now let's add a third line to the program you've written. The third line is to say BORN TODAY. Can you figure out how to add that line?

You did it if your program now reads . . .

```
10 PRINT "HAPPY BIRTHDAY"
20 PRINT "TO EVERYONE"
30 PRINT "BORN TODAY"
```

Press ENTER, and RUN

Now, to write a new program!
Type NEW and press ENTER.

THE COMMAND NEW ERASES OLD PROGRAMS IN THE COMPUTER.

To show you that your program is indeed erased, type LIST and press ENTER.
No program, right?
The computer just came back with READY because the program is erased.
From now on, always erase your old program before typing a new one in your computer.
Type this line in your computer:

```
10 CLS
```

THE COMMAND CLS CLEARS THE COMPUTER SCREEN.

It is helpful to clear the screen at the start of a program.
On the second line of your program, have the computer print your name.

```
20 PRINT "          "
```

RUN and LIST your program.
See how CLS works?

What happens when you mispell a command?

Put this program in your computer and mispell PRINT as PRONT.

10 PRONT "What's up, Doc?"

ENTER and RUN
What does your computer tell you when you try to RUN the program?

?SN Error means syntax Error.

A SYNTAX ERROR MEANS THAT YOU HAVE TOLD THE COMPUTER SOMETHING THAT IT DOESN'T UNDERSTAND.

You get ?SN Error when you misspell a command like PRINT. When you get ?SN Error, push ENTER to see your mistake. Push the ENTER Key. See? Now retype line 10 correctly.
RUN and LIST the program.

If you find a mistake in a program line after you have entered it, you can correct the line by retyping it.

You also get ?SN Error when you misspell a direct command.
Try telling your computer to RIN (instead of RUN).
Ask your computer to LAST your program (instead of LIST).
Now tell your computer to GNU (instead of NEW).
See what ?SN Error means?

Well, now it's time for you to go to the lesson review on the next page and then to some exercises. These exercises will come after every lesson. Here are some hints to help with the exercises:

HELPFUL HINTS

1. TAKE YOUR TIME AND DON'T GIVE UP. THINK.
2. TELL YOUR COMPUTER NEW EACH TIME TO ERASE THE OLD PROGRAM.
3. DON'T FORGET TO NUMBER YOUR PROGRAM COMMANDS.
4. DON'T PUSH ENTER UNTIL EACH LINE IS CORRECT.
5. DON'T FORGET THE QUOTATION (" ") MARKS WITH PRINT.
6. A ZERO LOOKS LIKE THIS: Ø (SEE THE LINE IN IT?)
7. THE LETTER O DOESN'T HAVE A LINE IN IT.

REVIEW OF LESSON ONE

To be sure that you fully understand everything you've learned up until now, read the definitions in the columns at the righthand side of the page. Choose a word from the column at the lefthand side of the page that means the same thing and write it in on the blank line before the first word of the definition.

PROGRAMMING
ENTER
RUN
LIST
" "
10, 20, 30
COMMANDS
SHIFT
NEW
CLS
←

_____ Push this key after every direct command and program line to place them in the computer's memory.

_____ Tells the computer to show you a list of its programs.

_____ Telling a computer what to do.

_____ Quotation marks — they are placed at the beginning and at the end of words you want the computer to PRINT.

_____ Clears the screen.

_____ Tells the computer to do what you have programmed it to do.

_____ The best way to number lines of your program. It makes it easy to add lines in the middle of the program.

_____ Back Space Key — it erases letters.

_____ Hold this key down to type the special character shown at the top of another key.

_____ Erases the old program in the computer.

_____ Words the computer understands.

EXERCISE 1-1

Put this program into your computer:

```
10 CLS
20 PRINT "THIS IS YOUR PROGRAM"
```

RUN this program two or three times.
LIST this program. Take a look at it.
Now add these lines:

```
11 PRINT
12 PRINT
13 PRINT
14 PRINT
15 PRINT
```

RUN the program now and see what happens. See how the message from line 20 is moved down towards the middle of the screen.

Lines 11, 12, 13, 14, and 15 do not tell the computer what to PRINT, so the computer didn't print anything! Each of these PRINT commands with nothing after them tells the computer to print a blank line.

Now add 4 more blank print lines:

```
16 PRINT
17 PRINT
18 PRINT
19 PRINT
```

RUN and LIST your program.

PRINT COMMANDS WITH NOTHING AFTER THEM TELL THE COMPUTER TO PRINT BLANK LINES

EXERCISE 1-2

Put this program into the computer's memory (don't forget the NEW command):

```
10 CLS
20 PRINT "H"
30 PRINT "E"
40 PRINT "L"
50 PRINT "L"
60 PRINT "O"
70 PRINT
80 PRINT "HUMAN"
```

RUN your program.

```
H
E
L
L
O

HUMAN
```

Now add program lines with blank PRINT commands so that each letter of the word (HELLO) will have a blank line after it.
For example, you could add:

```
25 PRINT
```

Do the rest on your own.
When you have the new lines added to the program, RUN it.

```
H

E

L

L

O

HUMAN
```

EXERCISE 1-3

Here's how to erase a whole line from the computer's memory:
Just type the line number and press ENTER.
To try it, first ENTER this line into the computer:

10 PRINT "HELLO EVERYONE"

RUN this program.

HELLO EVERYONE

Now type the number 10 and press ENTER.
Now try to RUN the program. Try to LIST it!
What happened when you typed the 10 and pressed ENTER?
NOTHING!

TYPING A LINE NUMBER WITH NOTHING AFTER AND PRESSING ENTER ERASES THE ENTIRE LINE NUMBER FROM THE COMPUTER'S MEMORY.

EXERCISE 1-4

Put this program into the computer:
(Don't forget NEW!)

```
10 CLS
20 PRINT "HERE IS LINE 20"
21  PRINT
22  PRINT
23  PRINT
24  PRINT
25  PRINT
26  PRINT
30 PRINT "HERE IS LINE 30"
```

RUN your program.

```
HERE IS LINE 20


HERE IS LINE 30
```

LIST your program.

Now, go back and erase lines 21, 23, and 25. RUN and LIST the program now. What difference do you notice?

```
HERE IS LINE 20
HERE IS LINE 30
```

EXERCISE 1-5

By using a PRINT command on lines 10, 20, 30, and 40, program your computer to PRINT the following information:

YOUR NAME

YOUR ADDRESS

YOUR CITY, STATE and ZIP CODE

YOUR BIRTHDATE

After you RUN and LIST your program, add these lines:

15 PRINT "HE LIVES AT" (If you are a girl PRINT "SHE")
25 PRINT "IN"
35 PRINT "HIS BIRTHDAY IS" (If you are a girl PRINT "HER")
45 PRINT "SEND A BIRTHDAY CARD AND MONEY"

EXERCISE 1-6

To get the computer to leave blank spaces before starting to PRINT a word, you must put the blank spaces inside the quotation marks. (See the example below.)

EXAMPLE

```
35 PRINT"   RELATED"
```

Program your computer to PRINT the following display on an angle:
Start off your program with a CLS command.

```
COMPUTER
  RELATED
    ENRICHMENT
      AND
        TECHNOLOGICALLY
          INSPIRED
            VIABLE
              EDUCATION
```

(See how that spells CREATIVE down one side?)

LESSON 2: GOTO

So far when you write a program, the computer goes through all your commands step by step. It starts with the lowest line number it finds and goes through to the highest. With the command GOTO you can make the computer go to whatever line you want. (You're really going to like this!)
Put this program into your computer:

```
10 PRINT "SOMETIMES COMPUTERS SEEM TO GO CRAZY!!"
20 GOTO 10
```

RUN this program and watch what happens.
To regain control of your computer, just press BREAK.
RUN and BREAK a few more times. See Figure 8.

THE BREAK KEY STOPS A PROGRAM FROM RUNNING.

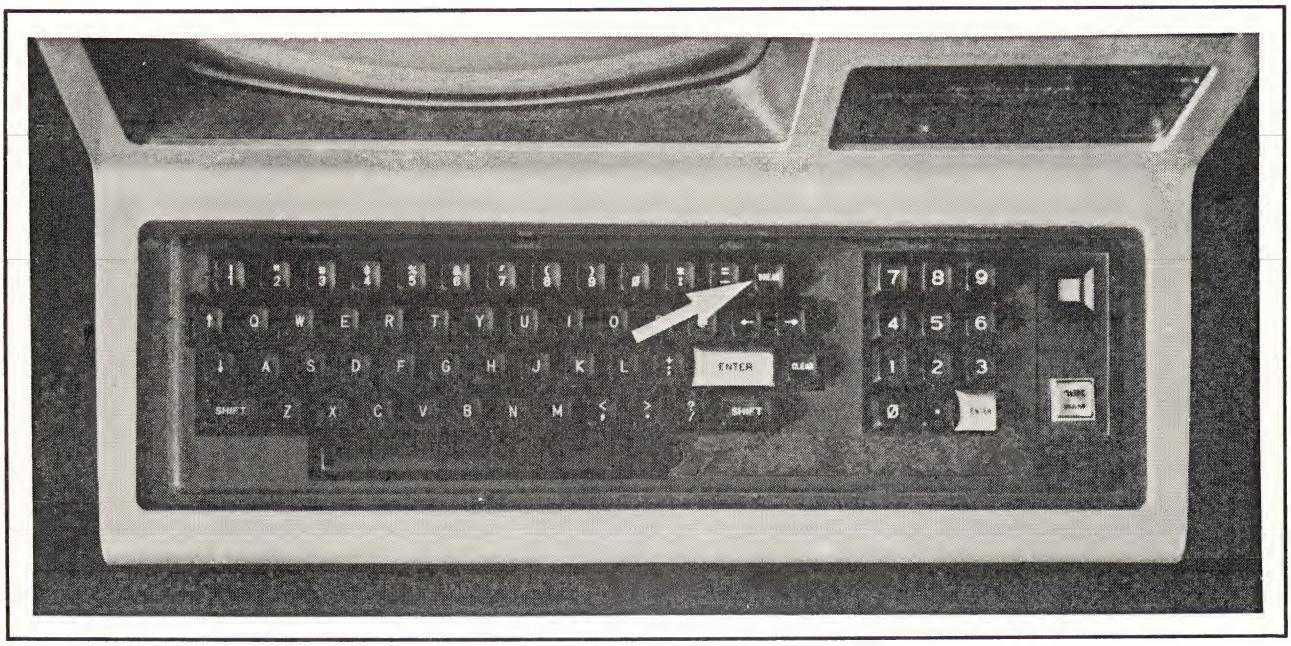

Figure 8

Now try this program:

```
10 CLS
20 PRINT "GOTO CAN SEND THE COMPUTER"
30 PRINT "BACK TO THE SAME LINE"
40 PRINT "OVER AND OVER AND"
50 GOTO 40
```

RUN and BREAK this program on your own.

GOTO IS A COMMAND THAT TELLS THE COMPUTER TO GO TO A CERTAIN LINE IN THE PROGRAM.
GOTO MUST BE FOLLOWED BY A LINE NUMBER.
GOTO DOES NOT USE QUOTATION MARKS!

Try this program:

```
10 CLS
20 PRINT "A HUMAN"
30 PRINT "NEVER"
40 PRINT "MAKES MANY"
50 PRINT "MISTAKES."
```

Get this to RUN. Now add:

```
25  GOTO 40
```

RUN this program. The message your computer will now PRINT has the opposite meaning of the message in the program above. LIST and try to figure out why the computer PRINTed what it did.

Then tell your computer NEW and go on.

Now put this program in your computer:

```
10 CLS
20 PRINT "LEARNING TO BE A"
30 PRINT "GREAT COMPUTER PROGRAMMER"
40 PRINT "USUALLY TAKES"
50 PRINT "VERY LITTLE"
60 PRINT "TIME."
```

After you get this program to RUN correctly, add one GOTO command so the computer will GOTO line 60 after line 40 without following the command on line 50. RUN and see your new message. HINT: Look at the last program example.

Here's a new program to try.
Think of something you really dislike.
Then put the following program — with your name and thing — into the computer:

```
10 PRINT "your name DISLIKES your thing!!!"
20 GOTO 10
```

RUN your program. Get it to stop by pushing the BREAK key.

USE THE BREAK KEY TO BREAK INTO A PROGRAM.

Write a program with a PRINT line and GOTO like the one above, but do something you love.
After you have written your program, put it in your computer and RUN it.
Use BREAK to stop.
RUN and BREAK some more on your own.

GOTO CAN MAKE THE COMPUTER SKIP AHEAD OVER LINES, OR GOTO CAN KEEP SENDING THE COMPUTER BACK OVER THE SAME LINE AGAIN AND AGAIN.
WHEN GOTO KEEPS SENDING THE COMPUTER BACK OVER THE SAME LINE AN ENDLESS LOOP IS FORMED.

Write another program with PRINT line and GOTO as before. You will create an endless loop and your message will keep PRINTing over and over. This time, make up your own message about anything.

After you get your program to RUN, try stopping it in this way:

Hold down one of the SHIFT keys with one hand; push the @ key with the other hand. See Figure 9.

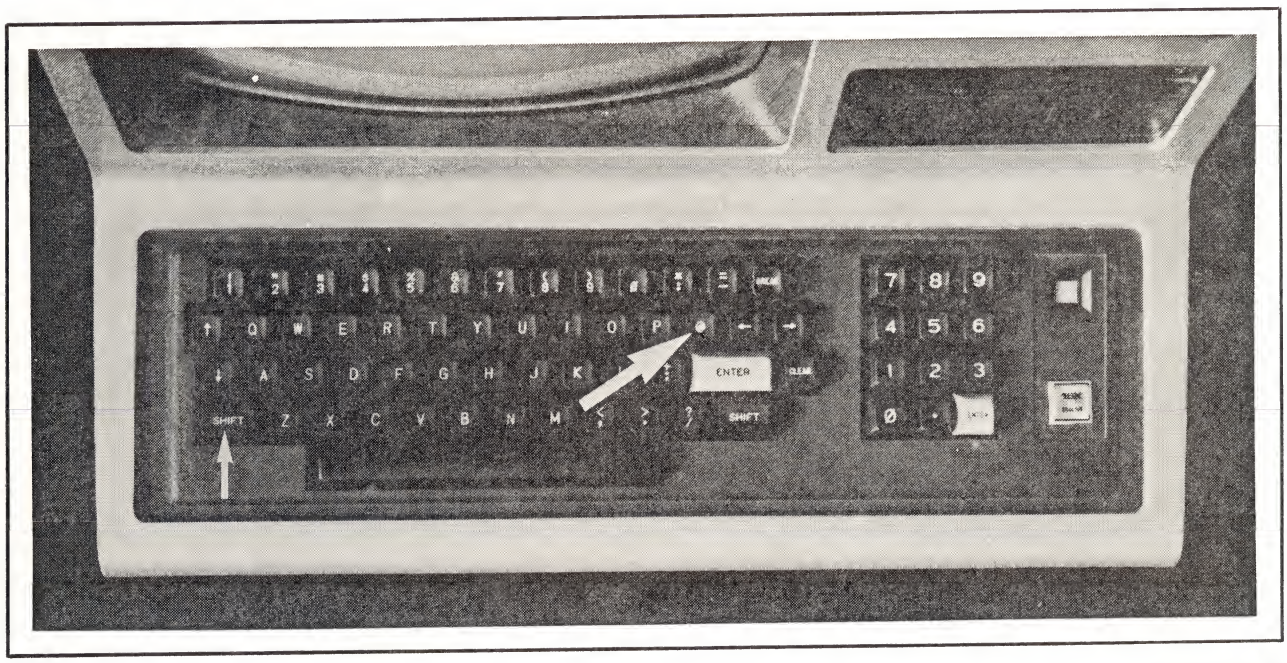

Figure 9

SHIFT @ stops a program.

To get your program RUNning again, just push any of the keys except for SHIFT or BREAK. Try it. See what happens?

Use SHIFT @ to stop your program again. Now try another one of the keys to start your program. Now BREAK your program. See how BREAK differs from SHIFT @?

What about getting two lines to PRINT over and over again using GOTO? Let's see what happens when you put this program into your computer:

```
10 PRINT "your name IS THE WORLD'S BEST PROGRAMMER."
20 PRINT "THIS DOES NOT COMPUTE!!!!"
30 GOTO 10
```

RUN.

Can you read the message? Stop your program with BREAK or SHIFT @ and take a look at your screen. RUN and stop it again. Can you think of a way to make it easier to read?
Try adding this line:

```
25 CLS
```

Now the computer will clear the screen each time. Since your message will be PRINTed in the same spot, it will be easier to read than before, but not much easier.
LIST your program.
Is there an endless loop in this program?
(ANSWER: Yes. Can you see how the GOTO command in line 30 creates an endless loop?)

EXERCISE 2-1

The PRINT commands in the program below contain a message. See if you can figure out what the message is just by looking at the program. Then put the program in your computer and RUN it.

```
 10 GOTO 130
 20 PRINT "RIGHT,"
 30 GOTO 170
 40 PRINT "YOU"
 50 PRINT "PROGRAM"
 60 GOTO 190
 70 PRINT "MAKE"
 80 GOTO 150
 90 PRINT "WILL"
100 GOTO 70
110 PRINT "IF"
120 GOTO 40
130 CLS
140 GOTO 110
150 PRINT "SENSE."
160 END
170 PRINT "IT"
180 GOTO 90
190 PRINT "THIS"
200 GOTO 20
```

THE COMMAND END TELLS THE COMPUTER TO STOP THE PROGRAM AND TO GO BACK TO BEING READY FOR YOUR COMMANDS.

EXERCISE 2-2

With a pencil or pen, put the words below in the proper blanks so that the message MARY HAD A LITTLE LAMB is PRINTed. Then put the program into your computer and see if you have done it correctly.
(The first word has been done for you.)

```
10 GOTO 120
20 PRINT "_____"
30 GOTO 100
40 PRINT "_____"
50 GOTO 80
60 PRINT "____MARY_____"
70 GOTO 20
80 PRINT "_____"
90 END
100 PRINT "_____"
110 GOTO 40
120 CLS
130 GOTO 60
```

Put these words in the blanks

HAD

A

LITTLE

LAMB

EXERCISE 2-3

Study the two programs below; how will the second program look different from the first program?"

FIRST PROGRAM

```
10 CLS
20 PRINT "CAN YOU SEE THE DIFFERENCE?"
30 GOTO 20
```

SECOND PROGRAM

```
10 CLS
20 PRINT "CAN YOU SEE THE DIFFERENCE?"
30 GOTO 10
```

Try both programs in your computer. See if you were right.

INTRODUCTION TO GRAPHICS

LESSON 3: MORE ABOUT RUN AND LIST

This lesson has two parts: a program and some instructions. We will use this program to show more ways to use RUN and LIST.

Here's the first part. Put these lines into your computer exactly as they are below.

```
210 FOR Y=0 TO 47
220 SET (X,Y)
230 NEXT Y
240 X=X + 1
250 FOR Y=47 TO 0 STEP -1
260 SET (X,Y)
270 NEXT Y
280 X=X + 1
290 IF X=126 THEN END
300 GOTO 210
```

RUN

this program and you'll see your computer turn on all its graphics squares.

BESIDES THE LETTERS AND CHARACTERS FROM THE KEYBOARD, YOUR COMPUTER CAN ALSO DISPLAY LIGHTED SQUARES THAT CAN GO TOGETHER TO MAKE LINES, CHARTS, AND PICTURES. MAKING DISPLAYS WITH THE LIGHTED SQUARES IS CALLED GRAPHICS.

You will get a full lesson on graphics later. All you need to do for now is put the graphics program into your computer. RUN your program a few times, then add these lines to get some instructions:

```
 10 CLS
 20 PRINT "THIS PROGRAM"
 30 PRINT
 40 PRINT "WILL SHOW YOU"
 50 PRINT
 60 PRINT "THE GRAPHICS"
 70 PRINT
 80 PRINT "YOU CAN GET"
 90 PRINT
100 PRINT "WITH THIS COMPUTER."
110 PRINT
120 PRINT "TO SEE THOSE GRAPHICS"
130 PRINT
140 PRINT "TYPE RUN 210 AND PUSH ENTER"
150 END
```

RUN

Then as the directions say, type:

RUN 210

and push ENTER

RUN 210 TELLS THE COMPUTER TO RUN THE PROGRAM IN ITS MEMORY BEGINNING WITH THE COMMAND ON LINE 210.
IF YOU JUST TELL THE COMPUTER RUN , IT ALWAYS STARTS WITH THE LOWEST LINE NUMBER.
YOU CAN TELL YOUR COMPUTER TO RUN FROM ANY LINE NUMBER IN YOUR PROGRAM.

Tell your computer to RUN 210 again. Try, RUN 100 and see what your computer does. Try RUN 50. Do you understand how that works? RUN your program one more time and follow the directions. Then let's go on.

Tell your computer to LIST your program. What happens? Sometimes the LIST of a program is too long to fit on the screen. When this happens, we ask the computer to LIST only a part of the program.

Type

LIST -150

and push
ENTER

(The dash before 150 tells the computer to list all the lines up to 150, including 150.)

Instead of telling the computer LIST -150 you could have done this:

LIST 0-150

and push
ENTER

The computer LISTs the lines from 0 to 150.

What if you wanted to LIST the lines the graphics program is on? Can you guess how to get them? You could tell the computer:

LIST 210-300

Or you could tell the computer:

LIST 210-

(The dash after 210 means LIST line 210 and all lines thereafter.) Try both ways. You can also ask your computer to LIST a single line. Type:

LIST 10

and push
ENTER

Your computer will LIST line 10.

IF YOU TYPE	THE COMPUTER WILL
LIST 50	LIST only line 50
LIST -50	LIST all the lines up to 50, including 50
LIST 50-	LIST 50 and all lines after
LIST 10-50	LIST the lines from 10 to 50

Do you understand how to use LIST with - and line numbers? Good! Use LIST - whenever you need it from now on. Now back to the lesson. A complete LIST of the graphics program in this lesson can be used to answer the following questions.

1. If you told your computer to RUN, what would be the first command the computer would follow?
2. Write down the line and command that keeps the computer from going into the graphics program.
3. What do you have to type to get the graphics part of the program to RUN?
4. How many blank PRINT lines are there in this program?
5. What do you have to type to LIST the lines from 10 to 150?

Let's review.

GRAPHICS PROGRAM WITH INSTRUCTIONS

```
 10 CLS
 20 PRINT "THIS PROGRAM"
 30 PRINT
 40 PRINT "WILL SHOW YOU"
 50 PRINT
 60 PRINT "THE GRAPHICS"
 70 PRINT
 80 PRINT "YOU CAN GET"
 90 PRINT
100 PRINT "WITH THIS COMPUTER."
110 PRINT
120 PRINT "TO SEE THOSE GRAPHICS"
130 PRINT
140 PRINT "TYPE RUN 210 AND PUSH ENTER"
150 END
210 FOR Y=0 TO 47
220 SET (X,Y)
230 NEXT
240 X=X + 1
250 FOR Y=47 TO 0 STEP -1
260 SET (X,Y)
270 NEXT
280 X=X + 1
290 IF X=126 THEN END
300 GOTO 210
```

REVIEW

←	BASIC	ENTER
CLS	END	graphics
endless loop	GOTO	NEW
LIST	LIST 70-	READY
PRINT	programming	" "
RUN	RUN 70	SYNTAX ERROR
SHIFT	SHIFT @	BREAK
10, 20, 30, etc.	20 PRINT	

USE THE WORDS ABOVE TO ANSWER THE FOLLOWING:

1. ready tells you the computer is ready for your commands.
2. programming is telling the computer what to do.
3. new tells the computer to "Erase old program."
4. ← is used to erase a wrong letter.
5. run tells the computer to follow the program in its memory.
6. cls erases the screen.
7. List tells the computer to show you the program in its memory.
8. Enter puts a command or line into the computer.
9. " " PRINT between these marks.
10. shift is used to type the top character on a key.
11. Print tells the computer to print something.
12. 10,20,30 ect are used to number program lines so you can add more later if needed.
13. Basic is the computer language your computer understands.
14. 20 Print would leave a blank line.
15. Syntax error means you gave the computer something it did not understand.

16. Goto _____ sends the computer to a certain line in the program.
17. Break _____ will stop an endless loop; needs only one hand.
18. Endless Loop _____ keeps sending the computer back over the same line.
19. Shift 0 _____ will break an endless loop; needs both hands.
20. _____ stops the program and tells the computer to go back to being ready for your commands.
21. _____ is the name for using the lighted squares.
22. _____ tells the computer to RUN the program in its memory beginning with the command in line 70.
23. _____ tells the computer to LIST line 70 and all the lines after.

LESSON 4: SAVING AND LOADING PROGRAMS

Sometimes, after you have created a long program, you'll want to save it just as you would save a model you've built or a recipe you like. There are two ways to save your program — on cassette tape or on a magnetic disk. If your computer is equipped with a cassette recorder, follow the directions given below to save your program on tape.

If your computer is equipped with a disk drive, you will follow the instructions given to save your program on a disk.

Here we can only assume that you already know how to use disks in your computer. From that point on, we can tell you how saving programs on a disk differs from saving material on recording tape.

The following pages will give you practice saving and loading programs.

EXERCISE 4-1

As a special reward for having worked so hard, how would you like to go to the motion pictures? Type this in your computer exactly as it is below. Try this program:
ENTER

```
 10 CLS
 20 PRINT"##########"
 30 PRINT"#    (.)   (.)   #"
 40 PRINT"#                #"
 50 PRINT"#       ---      #"
 60 PRINT"##########"
 70 FOR N=1 TO 50: NEXT N
 80 CLS
 90 PRINT"##########"
100 PRINT"#    (O)   (O)   #"
110 PRINT"#                #"
120 PRINT"#       ( )      #"
130 PRINT"##########"
140 FOR N=1 TO 50: NEXT N
150 GOTO 10
```

Look over this program and make sure you know how it works. The command in lines 70 and 140 is called FOR NEXT. In this program, FOR NEXT is used as a delay. The computer simply counts from 1 to 50 and then goes on to the next command. You will learn more about FOR NEXT in a later lesson.

EXERCISE 4-2

Using EXERCISE 4-1 as a model, make up a program with two faces that you create. The shape of the head must stay the same. The eyes, mouth, and nose should change. Use the same delays as in lines 70 and 140. Save this program on tape or on disk.

LESSON 4 — continued.

SAVING PROGRAMS ON DISKS

Programs can be saved on disks as well as on tape. If your computer has disk capability, the manufacturer's instructions will explain what a formatted disk is and exactly how to insert it into your computer.

1. First you must have a formatted disk already in disk drive 1 and a program in the computer you want to save. (Here we assume you have 2 disk drives. If you have 1 drive, call it drive Ø.
2. Type in the command SAVE and then quotation marks before and after the name of your program, then type a colon (:) and the drive number your disk is in (in this case disk drive 1). If your program name is N, your command will read:

SAVE "N:1"

Press
ENTER

(NOTE: THE NAME YOU GIVE YOUR PROGRAM SHOULD NOT BE MORE THAN 8 LETTERS LONG.)

3. The disk drive 1 should have the red light on and the motor running.
4. When the red light goes off, your program is SAVEd.

To check what you actually have on the disk, type:

CMD "D:1"

and
ENTER
Your program name should appear on the screen.

LOADING PROGRAMS FROM A DISK

To put a program on a disk back into the computer's memory:

1. Type LOAD then the name of your program . . .

LOAD "N:1"

press
ENTER

2. When the red light goes off, your program is back in the computer's memory.

Type
RUN
and your program should appear on the screen.

CSAVE "X": SAVING ON A CASSETTE TAPE

HOW TO CSAVE A PROGRAM ON TAPE:

1. First you must have a program in your computer that you want to save.
2. The next thing you need is a blank cassette tape.
3. Make sure the tape is REWOUND for the side you are going to record on. A cassette has two sides. If both sides are empty, record on Side 1, or Side A — it's easier to remember.
4. YOU CANNOT RECORD ON LEADER!!!! MAKE SURE RECORDING TAPE IS SHOWING! The most frequent mistake in CSAVE is forgetting to wind up the leader. If the tape you are using has a leader on it (it's usually red, blue, or white), take a pencil and wind the empty spool until the recording tape shows all the way across.
5. IF YOU ARE SURE your blank tape is ready to record, then carefully put it in the tape recorder and shut the lid.
6. Type CSAVE. Following that give your program a name by enclose a letter (any letter from A to Z) in quotation marks. Like this . . .

CSAVE "N"

THE LETTER MUST BE IN QUOTATION MARKS. " "

7. On your tape recorder, push PLAY and RECORD at the same time.
8. Next, on the computer, push ENTER.
9. When the computer tells you it is READY, the tape will have stopped moving. That will only take four seconds for a very short program of twenty commands. Very long programs may take minutes.
10. Rewind the tape. There are now 2 copies of the program; one in the computer, and one on the cassette tape.

To see if your program CSAVEd, properly type NEW and follow the instructions on loading a program from a tape.

HOW TO LOAD A PROGRAM FROM A TAPE INTO THE TRS-80 MODEL III™

1. Open the door to the tape recorder by pressing EJECT.
2. The cassette has two sides. The side with the program goes up.
3. Put the cassette into the tape recorder.

THE CASSETTE WILL ONLY FIT ONE WAY.
DON'T EVER FORCE IT!!! BE GENTLE!

4. Close the lid. Make sure the tape is rewound; push REWIND. When the tape is rewound, push STOP.

EXTRA STEP: Push the orange reset button on your keyboard. The computer will ask . . .

Cass?

Push the letter H for high speed. Push L for low speed. The program you just CSAVEd is H, since Model III computers CSAVE at high speed. Push ENTER and go on.

5. On the computer type:

CLOAD

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CLOAD IS A COMMAND. IT MEANS "LOAD THE PROGRAM ON THE CASSETTE INTO THE COMPUTER'S MEMORY."

6. On the tape recorder press PLAY.
7. On the computer press ENTER.
8. In a few seconds, you should see ** in the corner of your screen. DON'T DO ANYTHING! When the second * is blinking, the program is being loaded.
9. When the tape stops turning and your screen says READY, the program has been loaded.
10. Press STOP on the tape recorder. Then REWIND. When the tape has been rewound, press STOP.
11. Put one hand over the tape recorder lid and with the other gently push EJECT.
12. Take the tape out. Close the lid.

NEVER PUT A TAPE NEAR HEAT, ELECTRICITY, FOOD, OR WATER. THESE THINGS MAY DAMAGE THE PROGRAM.

13. Tell the computer to RUN the program you have just CLOADed.

IF SOMETHING DIDN'T WORK, try it all again and make sure you have done everything right.

14. After you CLOAD program, you want to make sure you have the program exactly as it was on the tape. One way to check a program is to RUN it. Another way is to use the command CLOAD? (The ? (question mark) is the key to the test command.)

CLOAD? TELLS THE COMPUTER TO COMPARE THE PROGRAM IN THE COMPUTER WITH THE PROGRAM ON THE TAPE.

Here's how to use CLOAD? to check a program.*

1. CLOAD a program from a tape.
2. REWIND the tape. STOP the tape.
3. On your computer type:

CLOAD? (with a question mark)

4. On the recorder press PLAY.
5. On your computer press ENTER. Just as before the tape will turn. This time the program will not go into the computer. The computer will only compare each line from the program on the tape with the program in the memory.
6. When your computer says READY, it means that the program in the memory is exactly the same as the one on the tape.
7. If you do not get READY, it means that the program in the memory is not exactly the same as the one on the tape; try again.
8. After CLOAD? take care of your tape just as you would after CLOAD.

*You cannot CLOAD? a low speed cassette on MODEL III.

LESSON 5: FOR NEXT

This is a lesson on the command FOR NEXT. First we need to go over equations. You don't know what an equation is? DON'T PANIC! That's why we are going to go over them.

An equals sign looks like this = . Find it on your computer. See Figure 10. If you were to say, "A nickel equals 5 cents," would you know what it meant?

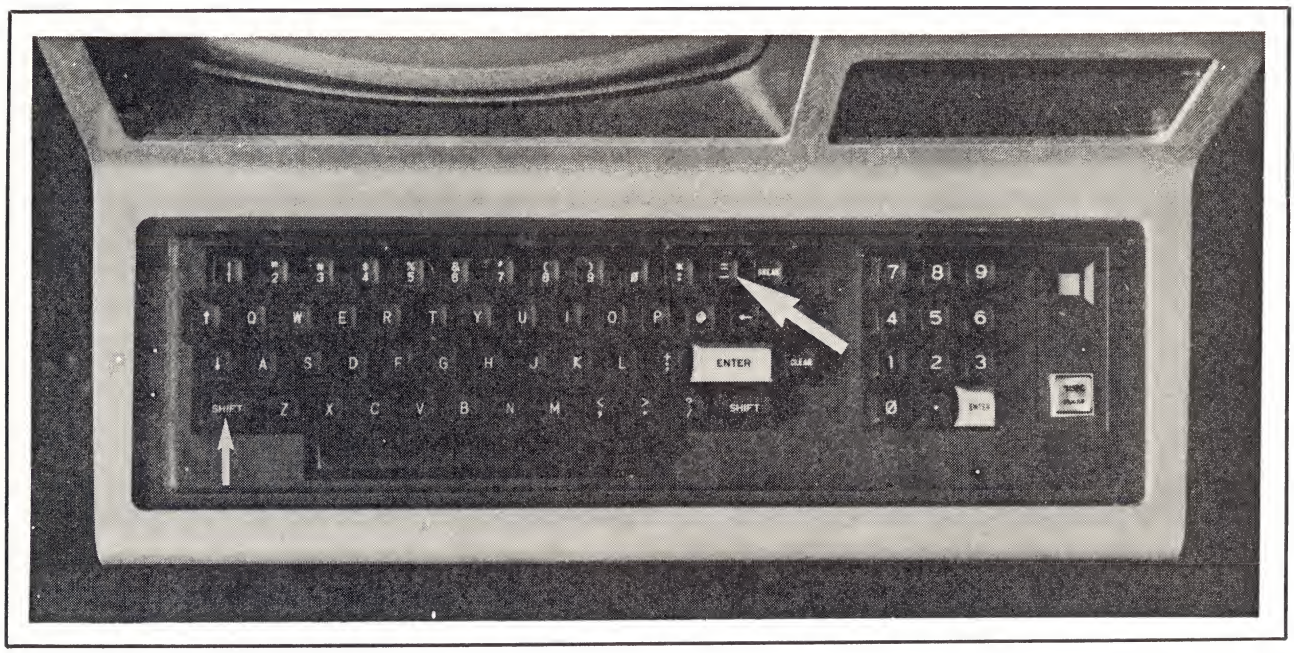


Figure 10

you would be saying,
"A nickel has a value of, or, is the same as 5 cents."
Get it? Or you could write: nickel=5 cents.

Do you know what initials are? They are the first letters of your names. Does a nickel have an initial? Well, just like your initials stand for your name, we could let N stand for nickel.

We could write: nickel=5 cents or N=5

ENTER the following program into your computer:

ENTER
10 N=5
20 PRINT N (do not use quotation marks in this line!)

RUN
this program.
What does your computer PRINT? Can you see why?

WHEN YOU USE THE COMMAND PRINT AND THEN JUST A LETTER WITH NO QUOTATION MARKS, THE COMPUTER WILL PRINT THE VALUE OF THAT LETTER.
IF YOU HAVE NOT SAID WHAT THAT LETTER EQUALS, THE COMPUTER SETS ITS VALUE AT 0.

Erase line 10 by typing 10 and pushing ENTER.
RUN
your program now.
What does the computer PRINT?
LIST
your program. Since you did not give N a value in this program, the computer sets its value at 0.

To get some practice with equations, try this program:

10 PRINT X	(The computer will print 0 — since you did not give X a value.)
20 Y=5	
30 PRINT Y	(The computer will PRINT 5 — since that is the value you gave Y.)
40 Z=10	
50 PRINT Z	(The computer will PRINT 10 — see why?)
60 PRINT "Z"	(The computer will PRINT a "Z" — since you used quotation marks.)

RUN and LIST this program a few times.

Make sure you understand exactly how it works.

take a look at this next program. Figure out what the answers will be, then try it in your computer to see if your answers were right. WHAT WILL THE COMPUTER PRINT?

```
10 PRINT A
20 B=29
30 PRINT B
40 PRINT C
50 D=92
60 PRINT "D"
```

Remember when we let N stand for nickel and said N=5? N is called a VARIABLE. N could stand for a lot of things: Nancy, nails, nuggets, etc. But for our equation we let the variable N stand for nickel. Are you getting this equation business? Good! You are ready for FOR NEXT!

ENTER

```
 10 X=1
 20 PRINT X
 30 X=2
 40 PRINT X
 50 X=3
 60 PRINT X
 70 X=4
 80 PRINT X
 90 X=5
100 PRINT X
RUN
```

What numbers does the computer PRINT? See how X takes whatever value you assign it in your program? Go on; see how to do this program with FOR NEXT?

NOTE: = TO THE COMPUTER MEANS "LET WHAT IS ON THE LEFT, HAVE THE VALUE OF WHAT IS ON THE RIGHT.

Erase your old program with NEW and try this program:

```
ENTER
10 FOR X=1 TO 5
20 PRINT X
30 NEXT X
RUN
```

To learn how FOR NEXT works, read on! Did anyone ever say something like: "For the next two weeks you have to come straight home from school. And I mean it"? Notice the use of the words for and next. The command FOR NEXT on the computer works a lot like that statement.
LIST that last program and let's take a look at it.

10 FOR X=1 TO 5	This tells the computer for how long.
20 PRINT X	This tells the computer what to do.
30 NEXT X	This says go to the next number — here the computer will stop at 5.

FOR NEXT IS TWO SEPARATE COMMANDS THAT WORK TOGETHER. FOR NEXT USES A VARIABLE. YOU CAN USE ANY LETTER. IT DOES NOT HAVE TO BE X.

ENTER

10 FOR D=1 TO 25	This tells the computer for how long.
20 PRINT D	This tells the computer what to do.
30 NEXT D	This says go to the next number.

Can you figure out what will happen when you RUN this program? RUN it and see if you were right.

Now try this program:

```
10  FOR G=1 TO 13          This tells the computer for how long.
20  PRINT "your name"      This tells the computer what to do.
30  NEXT G                 This says go to the next number.
RUN
```

Count the number of times your computer PRINTed "your name." I bet it was 13. That's because in line 10 you told the computer FOR G=1 TO 13.

FOR NEXT IS A WAY TO GET THE COMPUTER TO DO SOMETHING A CERTAIN NUMBER OF TIMES.

Is this FOR NEXT business starting to make sense? I think you're ready for some EXERCISES!

EXERCISE 5-1

Write a program with FOR NEXT that will have your computer PRINT the numbers from 1 to 1000. Use a variable besides X. (Why not use your first initial?)

EXERCISE 5-2: SOME COMMON ERRORS

Let's take a short breather. You've learned a lot. Using FOR NEXT can be a little confusing. But you're doing really well!

Before we get back to programming, how about a quick look at these errors that might take place with FOR NEXT.

1. FOR with no NEXT

Put these lines in your computer:

```
10  FOR B=1 TO 1000000
20  PRINT B
```

What does your computer PRINT when you RUN this program? (The computer PRINTs the first B and then quits because you haven't told it to go on to the NEXT one.)

2. NEXT without a FOR

Now try this program:

```
10 PRINT P
20 NEXT P
```

What does the computer PRINT when you RUN this program? (The computer PRINTs 0 and in the following line it prints ?NF ERROR IN 20.)

FOR AND NEXT WERE MADE TO WORK TOGETHER.
ONE IS NO GOOD WITHOUT THE OTHER.

EXERCISE 5-3

ENTER

```
10 FOR X=1 TO 50
20 PRINT "I'M ON NUMBER" X "NOW."
30 NEXT X
40 PRINT "I'M FINISHED."
RUN
```

Take a close look at line 20.

```
20 PRINT "I'M ON NUMBER" X "NOW."
```

The X is outside the two sets of quotation marks, so the computer PRINTs the value of X, not the letter X.

REMEMBER:
PRINT X THIS GIVES YOU THE VALUE OF X.
PRINT "X" THIS GIVE YOU AN X.

EXERCISE 5-4

ENTER

```
10 FOR C=1 TO 500
20 PRINT "I'M UP TO" C "NOW!"
30 NEXT C
40 PRINT
50 PRINT "I'M DONE."
RUN
```

Your turn: Write a program that will do the following things:

1. Have the computer count up to a number of your choosing.
2. PRINT this: "I'M ON (the number) ALREADY!"
3. After the numbers are all through, PRINT: "O.K. I'M DONE!"

Use a difference variable besides C.

After you get your program written, RUN it in your computer.

EXERCISE 5-5

ENTER

```
10 FOR V=100 TO 200
20 PRINT "I'M ON" V "NOW."
30 NEXT V
RUN
```

The computer does not have to start with 0 or 1 in a FOR NEXT program. It can start wherever you program it to. In this program, the computer starts with 100.

Program your computer to PRINT the numbers from 900 to 1000 by changing one line in the program above. Try some other numbers on your own.

EXERCISE 5-6

Earlier, you learned how to use the command GOTO to PRINT a message over and over. (Can you remember that far back?) In case you need a little refresher, please turn to page 22, put this program in your computer and RUN it.

```
10 PRINT "PROGRAMMING IS FUN!"
20 GOTO 10                          (THIS IS A  GOTO  LOOP)
```

Do you remember how to stop this program? You know two ways. Try them both. Let's go on. What if I didn't want "PROGRAMMING IS FUN!" to RUN forever, but only 100 times? How could I do that? By using FOR NEXT. Try this program and see.

ENTER

```
10 FOR Q=1 TO 100
20 PRINT "PROGRAMMING IS FUN!"      (THIS IS A  FOR NEXT  LOOP)
30 NEXT Q
```

USE A GOTO LOOP TO DO SOMETHING ENDLESSLY.
USE A FOR NEXT LOOP TO DO SOMETHING A CERTAIN NUMBER OF TIMES.
A FOR NEXT LOOP INCLUDES THE FOR COMMAND, THE NEXT COMMAND, AND ALL THE COMMANDS IN BETWEEN.

EXERCISE 5-7: USING FOR NEXT AS A DELAY

Here's the general format we have been using with FOR NEXT:

ENTER

```
10 FOR X=1 TO 50
20 PRINT "I'M O.K.!"
30 NEXT X
```

You know how this program would RUN, right?
The computer would PRINT "I'M O.K.!" 50 times.
Take a look at this program:

```
ENTER
10 FOR X=1 TO 500
20 NEXT X
RUN
```

this program in your computer and see what happens. Look at the program. It looks like we forgot the command that comes between FOR and NEXT to tell the computer what to do. In this program we didn't ask the computer to do anything, so all it does is count from 1 to 500.

USING FOR NEXT WITH NO COMMAND BETWEEN MAKES A DELAY. THE COMPUTER SIMPLY PAUSES AND COUNTS FROM THE FIRST NUMBER TO THE LAST AND THEN GOES ON.

RUN your program again. You'll see that the computer takes about one second before being READY for your commands again.

THE COMPUTER TAKES ABOUT 1 SECOND TO COUNT 500 NUMBERS IN A FOR NEXT DELAY.

EXERCISE 5-8: USING A DELAY TO SLOW DOWN A PROGRAM

```
ENTER
10 FOR X=1 TO 10
20 PRINT "YOU'RE DOING TERRIFIC!"
30 NEXT X
RUN
```

See how fast the program goes? It's too fast to read until the program is over. Now add these lines:

```
25 FOR Y=1 TO 500
26 NEXT Y
RUN
```

Now the computer stops at line 25 and counts to 500 before going on. This slows the program down. It takes about one second before line 20 is PRINTed each time.

Change line 25 so that the computer will count to 1000.
Now there will be about 2 seconds delay. Try some other numbers.

BE CAREFUL TO USE DIFFERENT VARIABLES WHEN YOU HAVE ONE FOR NEXT LOOP INSIDE OF ANOTHER.

LESSON 6: CONT, STEP, COLON, COMMA and SEMICOLON

```
ENTER
10 FOR N=1 TO 5000
20 PRINT N
30 NEXT N
RUN
```

While the numbers go flashing by, push BREAK. The BREAK key breaks into a program. SHIFT @ stops a program. WITH BREAK YOU CAN CONTINUE WITH YOUR PROGRAM WHERE YOU LEFT OFF, OR, YOU CAN TELL IT TO RUN AGAIN FROM THE BEGINNING.

Have you got your program stopped by using BREAK? Take a look at the last number your computer PRINTed.

Now type:

CONT

and push ENTER. Watch carefully and see what number the computer starts with.

AFTER YOU BREAK YOUR PROGRAM WITH BREAK , YOU CAN TELL YOUR COMPUTER TO RUN , OR CONT .
WHEN YOU RUN , THE COMPUTER STARTS ALL OVER.
WHEN YOU CONT , THE COMPUTER CONTINUES WITH THE PROGRAM FROM WHERE IT LEFT OFF.

Experiment with this program and BREAK, SHIFT @, CONT, and RUN until you are sure you know how each one works.

STEP

In the last EXERCISE, you learned that the computer doesn't have to start counting with 1 in a FOR NEXT command. It can start with whatever number you choose. The computer can also count by whatever number you choose. Can you count by twos? (You know: 2, 4, 6, 8, and so on.) So can your computer.

ENTER

```
10 FOR X=0 TO 100 STEP 2
20 PRINT X
30 NEXT X
40 PRINT "THAT'S HOW I COUNT BY TWOS!"
RUN
```

STEP IS USED AFTER A FOR COMMAND.
STEP TELLS THE COMPUTER WHAT SIZE STEPS TO TAKE.
IF YOU DON'T SAY WHAT SIZE STEPS, THE COMPUTER STEPS BY 1.

Try this program to make sure you understand STEP.

```
ENTER
10 FOR Y=0 TO 200 STEP 5
20 PRINT Y
30 NEXT Y
40 PRINT "THAT'S COUNTING BY FIVES!"
RUN
```

MORE WITH STEP COMMAND

The command STEP can also make the computer take backwards steps. All you have to do is put a negative sign. It looks like this − , in front of the number. This program would make the computer count backwards in steps of 1 from 100 to 0.

```
ENTER
10 FOR L=100 TO 1 STEP −1
20 PRINT L
30 NEXT L
RUN
```

This program has the computer count down from 1000 to 1 in steps of 10.

```
ENTER
10 FOR T=1000 TO 1 STEP −10
20 PRINT T
30 NEXT T
RUN
```

Try both programs in your computer. Write a program that will tell your computer to count from 1 to 500 in steps of 20, and then count backwards from 500 back down to 1 in steps of 40. Think on this one!

THE COLON

Do you know what a colon is? You have one on your computer keyboard. A colon looks like this : . Find it? See Figure 11.

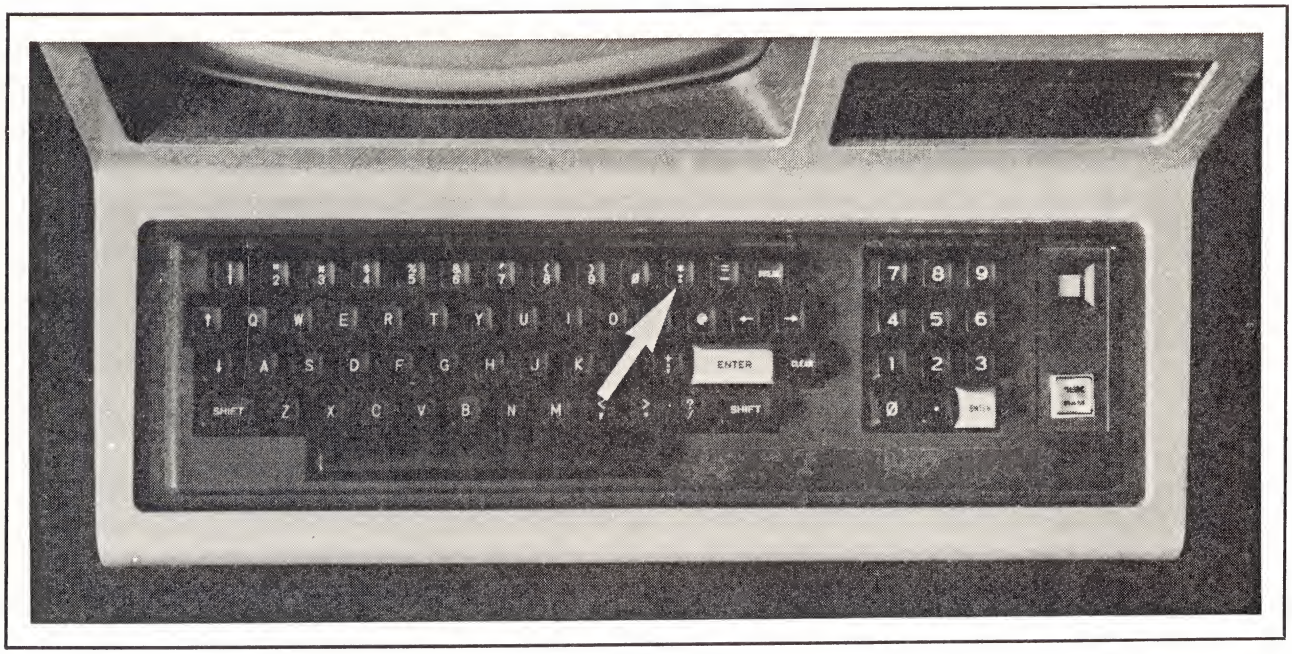


Figure 11

A COLON IS USED TO PUT TWO OR MORE COMMANDS ON THE SAME PROGRAM LINE.
EXAMPLE 30 PRINT "HELLO" : GOTO 20

Usually we only put one command on each program line. A LIST of a program is easier to read if we only put one command on each line. It is helpful to use a colon to put two commands on the same line as with a FOR NEXT delay. Look at these programs.

```
10 PRINT "STARTING"
20 FOR X=1 TO 1000
30 NEXT X
40 PRINT "FINISHED"
```

```
10 PRINT "STARTING"
20 FOR X=1 TO 1000:NEXT X
30 PRINT "FINISHED"
```

Both of these programs do exactly the same thing with the same commands.

IT DOESN'T MATTER IF YOU PUT A SPACE AFTER A COLON OR NOT. YOU WILL FIND OTHER INSTANCES WHEN A SPACE IS NOT NECESSARY.

THE COMMA AND SEMICOLON

This is about the comma which looks like this , and the semicolon which looks like this ; Find these symbols on your keyboard.

When you write a letter or a report, you may use commas and semicolons. Commas and semicolons are used in computer programs also, but in a computer program they have a different meaning than in letters or reports. Think about the RUN command. What does it usually mean? What does it mean on the computer?

All right! But what does a comma and a semicolon do on the computer?

THE COMPUTER UNDERSTANDS COMMAS AND SEMICOLONS AS WAYS OF CONTROLLING SPACE ON A LINE.
A COMMA MAKES YOU PRINT IN FOUR COLUMNS.
A SEMICOLON PRINTS ON A LINE UNTIL IT IS FULL.

EXERCISE 6-1

ENTER

```
 10 CLS
 20 PRINT
 30 PRINT "HERE ARE ALL THE EVEN NUMBERS"
 40 PRINT
 50 PRINT "FROM 0 TO 50"
 60 PRINT
 70 PRINT
 80 FOR X=0 TO 50 STEP 2
 90 PRINT X,
100 NEXT X
RUN
```

Notice when you use a comma with PRINT in line 90, the computer gives you the four columns.
Let's practice using the comma first. Try this program:

ENTER
```
10 PRINT "A", "B", "C", "D"
```

RUN
this program and you'll see the four PRINT columns.

THE SEMICOLON MAKES THE COMPUTER PRINT ON THE SAME LINE UNTIL THAT LINE IS FULL.

Try this program to see how the semicolon fills up a PRINT line:

ENTER
```
10 CLS
20 FOR X=1 TO 100
30 PRINT "your name ";
40 NEXT X
```
RUN

Change line 20 so your name is PRINTed two hundred times.

THE SEMICOLON TELLS THE COMPUTER TO PRINT RIGHT WHERE IT LEFT OFF. IF YOU WANT A SPACE BETWEEN THE WORDS YOU HAVE WITHIN QUOTATION MARKS, YOU MUST INCLUDE IT.

EXERCISE 6-2

You know that with the comma you can have 4 PRINT columns. You can also have 3 or 2 columns if you want. Try this:

```
ENTER
10 CLS
20 PRINT "YEAR", "YOUR AGE"      (This will make 2 headings.)
30 PRINT
40 FOR Y=1983 TO 1990
50 A=Y-the year you were born in
60 PRINT Y,A                     (This will make 2 columns.)
70 NEXT Y
RUN
```

EXERCISE 6-3

Experts say that soon we may be doing our shopping by computer. Here's a program to make a display you may see.

```
ENTER
 10 CLS
 20 PRINT "EGGS COST 89 CENTS A DOZEN THIS WEEK."
 30 PRINT
 40 PRINT "THIS MANY", "WOULD"
 50 PRINT "DOZEN", "COST"          column headings
 60 FOR E=1 TO 6
 70 PRINT E, "$" E*.89
 80 NEXT E
 90 PRINT
100 PRINT "WOULD YOU LIKE TO BUY ANY?"
RUN
```

NOTE:
TO SAY "MULTIPLIED BY" THE COMPUTER USES * (ASTERISK). THE COMPUTER USES * FOR MULTIPLICATION INSTEAD OF AN X.

EXERCISE 6-4

This program makes your computer screen look like an aquarium tank. All we need now is some fish!

```
ENTER
10 CLS
20 FOR X=1 TO 5000
30 PRINT "O   (keep spacing for 90 spaces!)  ";
40 NEXT X
RUN
```

Experiment with the number of spaces between the O and the " in line 30.

EXERCISE 6-5: YOUR SEMICOLON PROGRAM

Write a program that will say HERE ARE FIVE HUNDRED ZEROES.
Skip a line . . .
and then PRINT five hundred zeroes using the semicolon.

LESSON 7: SET and RESET

By now I'm sure you have played a game on your computer in which there are pictures of moving objects: little men, cars, robots, worms, etc. Most of those pictures are made by turning on little squares of lights called graphics. Have you been wondering when you were going to learn how to write a program to make those kinds of pictures? Well, guess what?
ENTER this line:

```
10 SET (63,23)
```

```
RUN
```

and watch what happens.

Your screen is divided up into a bunch of little squares, or lights, all of which can be turned on with SET. To make a picture, you just program the computer to turn on squares which together will form the shape of the image you want.

But how do you tell the computer which light to turn on? Simple. The first light in the upper left corner is numbered (Ø,Ø). From that spot, the numbering follows this pattern: (how many squares over?, how many squares down?)

SET (63,23) MEANS: TURN ON THE LIGHT WHICH IS 63 SQUARES OVER, AND 23 SQUARES DOWN. THIS LOCATION IS CALLED ITS ADDRESS POINT.

Right now take a quick look at the Graphics Worksheet. See how the squares are numbered? Does it look hard to understand? No problem — you can do it.

From the (Ø,Ø) point in the upper left corner, you can go over 127 squares until you get to the right side. You can go down 47 squares until you hit bottom. If you ever try to turn on a light with a number that is off the screen, the computer says:

?FC ERROR (or something like this)

FC stands for "Illegal Function Call' — or in easy language — "I CAN'T DO THAT!" Try SETting a light that is off the screen. ENTER

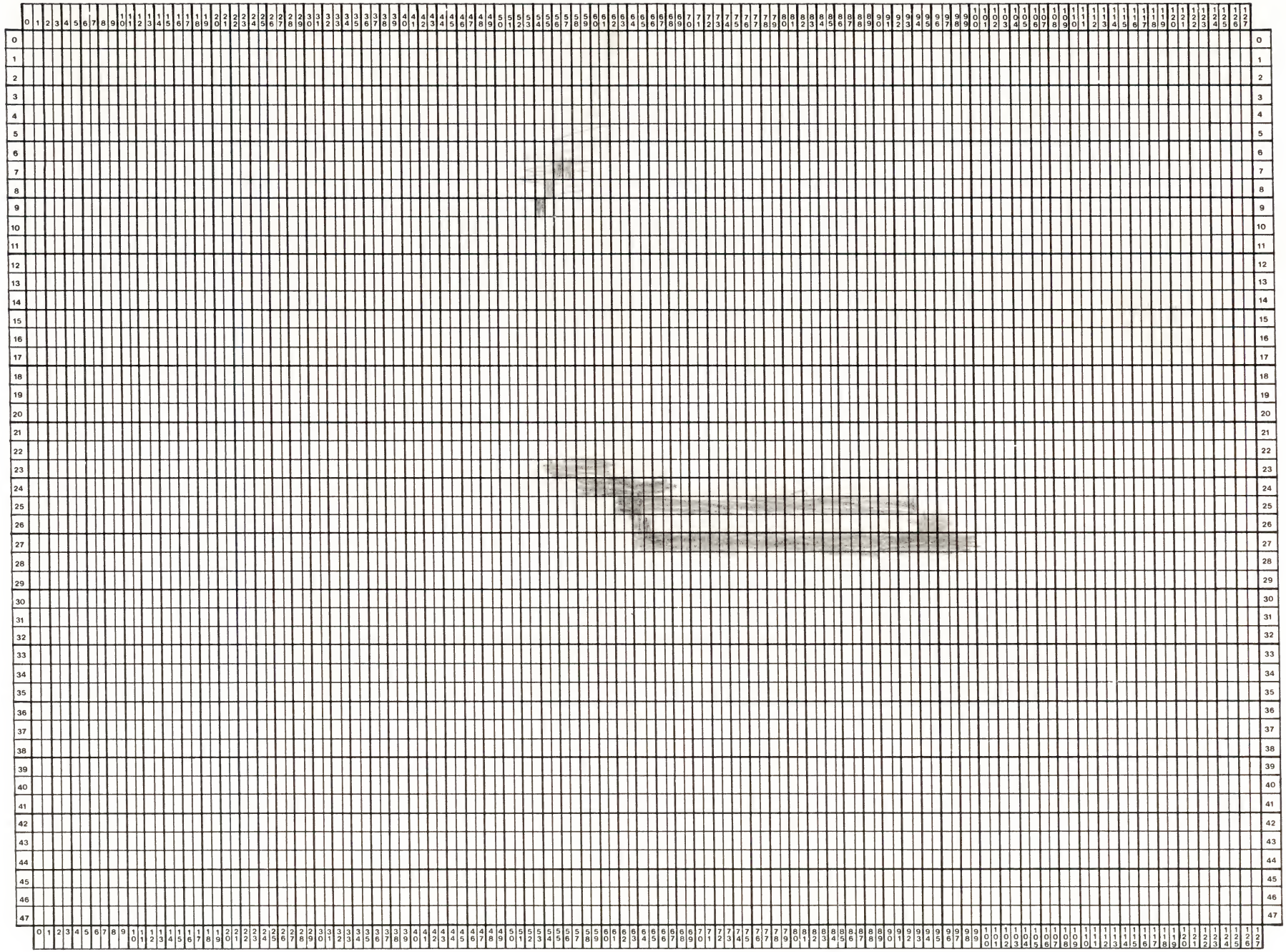
```
1Ø SET (128,48)

RUN
```

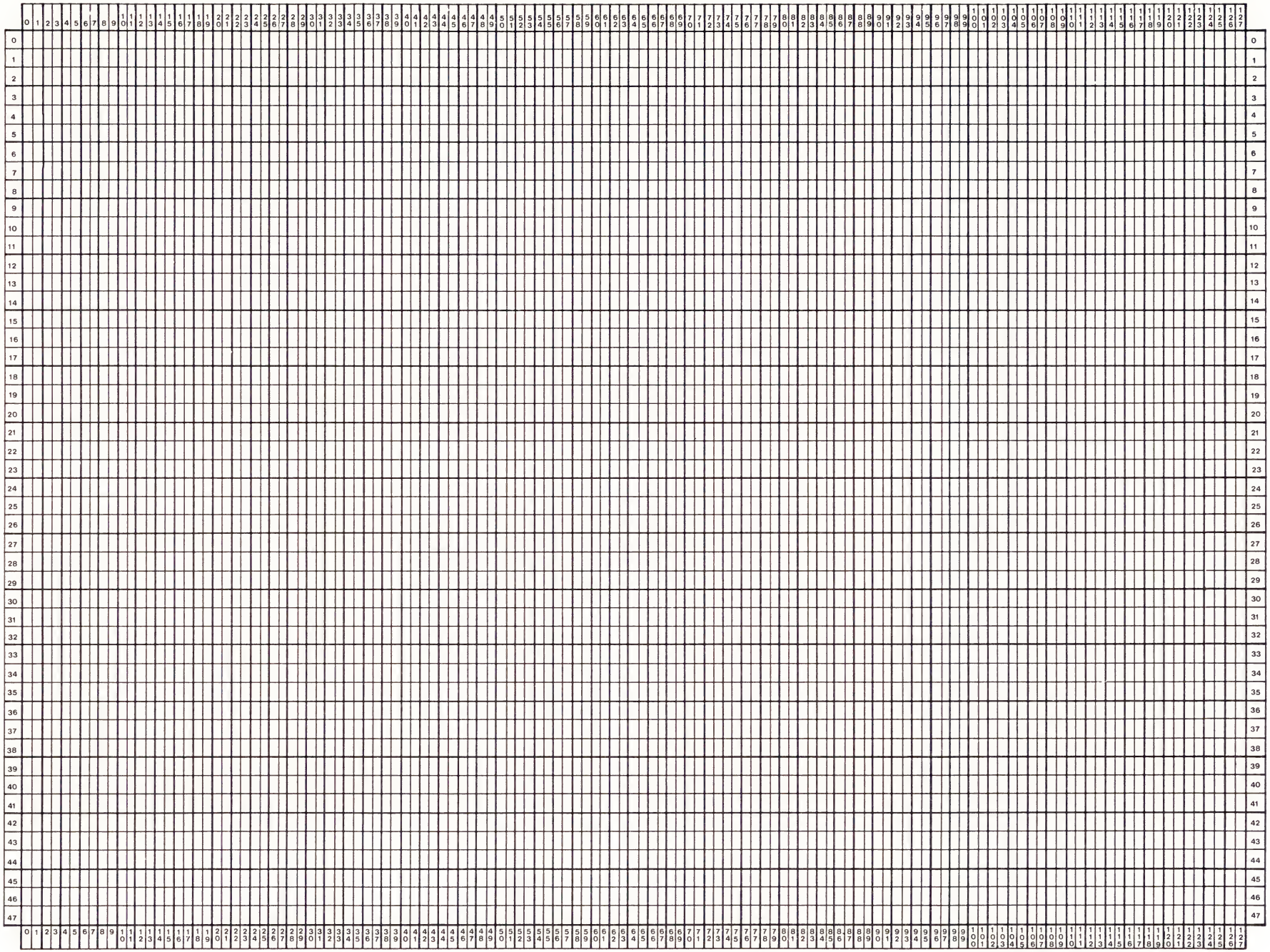
and see what happens.

TURNING ON LIGHTS WITH SET TO MAKE PICTURES IS CALLED GRAPHICS . THE CURSOR LINE WILL DISRUPT ANY GRAPHICS YOU MAY HAVE ON THAT LINE.

All this means is that as the cursor moves, it turns off any lights in its line. You'll experience this soon if you haven't already. The command to SET those lights is still in the memory.



GRAPHICS WORKSHEET



GRAPHICS WORKSHEET

SET MUST ALWAYS BE FOLLOWED BY THE LOCATION OF THE LIGHT INSIDE OF PARENTHESES. PARENTHESE LOOK LIKE THIS ( ) .

Two more items, and then we'll get back to programming:

1. Putting CLS at the beginning of a graphics program will make it look a lot better, so let's do it.
2. Putting a one line GOTO loop will keep READY and the cursor off the screen. Use a line like 999 GOTO 999, or some other high number. DON'T FORGET: You will have to BREAK out of this GOTO loop.

Now, back to programming.

ENTER

this program:

```
 10 CLS
 20 SET (63,23)
999 GOTO 999
RUN
```

(63,23) is the middle of the screen. Find it on the Graphics Worksheet. The last line of this program did not have to be 999 GOTO 999. It could have been 30 GOTO 30 or any other number greater than 20.

BREAK

this program. Now find the ↓ key. Push it and move the cursor line down until it wipes out the graphics. See how that works?

RUN and BREAK

your program a few more times.

Your last program turned on the light at (63,23), which means: (63 squares over, 23 squares down). Let's add a command to turn on the light right above it. What would its address be?

(63 squares over, 22 squares down) = (63,22)

So add this line:

```
30 SET (63,22)
```

RUN
your program and you should have two connecting lights.

What about the square below? That would be (63 over, 24 down). Add this line:

```
40 SET (63,24)
RUN
```

On your own — get the squares to the left (62,23) and right (64,23) to turn on also. RUN. you will have a cross in the middle of your screen.

If you wanted to turn on the four corners of the screen, what are the four lights you would set?

EXERCISE 7-1: FOUR CORNERS

ENTER
this program to turn on the four corners of the screen.

```
 10 CLS
 20 SET (0,0)
 30 SET (0,47)
 40 SET (127,0)
 50 SET (127,47)
999 GOTO 999
```

It did not matter which order you SET these lights. Did you get them right? Find these squares on the Graphics Worksheet. Remember, 999 GOTO 999 could have been any number higher than 50. Don't think there is something special about 999. All that one line GOTO loop does is keep READY off the screen.

RUN and BREAK
this program a few times.

EXERCISE 7-2: DRAW A LINE

Let's start at (0,0) and draw a line 10 squares long across the top of the screen.

ENTER

```
 10 CLS
 20 SET (0,0)
 30 SET (1,0)
 40 SET (2,0)
 50 SET (3,0)
 60 SET (4,0)
 70 SET (5,0)
 80 SET (6,0)
 90 SET (7,0)
100 SET (8,0)
110 SET (9,0)
120 GOTO 120
```

RUN

Do you see why this program turns on the lights that are 0 squares down, and from 0 to 9 squares over? Make sure you understand this program. Look back at the Graphics Worksheet if you need to. In the next EXERCISE, you have to draw your own line!

EXERCISE 7-3: DRAW YOUR OWN LINE

Write a program to draw a line 10 squares long down the left side of the screen. The first two squares are done for you.

```
 10 CLS
 20 SET (0,0)
 30 SET (0,1)
```

After you have written your program, try it out in your computer.

EXERCISE 7-4: YOUR INITIAL IN LIGHTS!

How about this? Write a program using SET to turn on lights that will be the shape of your first initial. Take your time and do a good job on this one! After you write your program, try it in your computer.

EXERCISE 7-5: BLINK

Here's a new command: RESET. Guest what it does? It turns off a light. Like SET, RESET must be followed by the lights's address inside of parentheses.

```
ENTER
10 CLS
20 SET (63,23)          This turns (63,23) on.
30 RESET (63,23)        This turns (63,23) off.
40 GOTO 20              This makes a loop to do it over and over.
RUN
```

(63,23) is the center of the screen. Watch the light located there be SET and RESET over and over. Pick another light to SET and RESET over and over. Try it in your computer.

EXERCISE 7-6: BLINKING X

Write a program that will use SET to turn on squares that will form an X on your screen. It can be as big or as small as you want. Then use RESET to turn off those same squares. Finally, use GOTO to go through the program all over again and again.

LESSON 8: GRAPHICS FOR NEXT LOOPS

Back in EXERCISE 7-3, one of the numbers in the light's address went from 0 to 9 and the other just stayed at 0. What if we could get FOR NEXT to put in the numbers from 0 to 9 for us? Let's do it!

```
ENTER
 10 CLS
 20 FOR X=0 TO 9   Can you see how these commands will SET these squares:
 30 SET (X,0)      (0,0) (1,0) (2,0) (3,0) (4,0)
 40 NEXT X         (5,0) (6,0) (7,0) (8,0) (9,0)
999 GOTO 999
RUN
```

The first time through the program, the computer lets X=0, so square (0,0) is SET. The next time through X=1, so (1,0) is SET, and so on. Get it? Isn't that a fast way to draw a line! Try this program to draw a line down the side.

```
ENTER
 10 CLS
 20 FOR X=0 TO 9
 30 SET (0,X)
 40 NEXT X
999 GOTO 999
RUN
```

The first time through the program, the computer will SET (0,0). What are the other nine squares that will be SET?

EXERCISE 8-1: DRAWING LONGER LINES

Can you imagine how many steps it would take to draw a line all the way across the top of your screen if we couldn't use FOR NEXT? It would take at least 128 SET commands! It would take a long time to ENTER that into your computer! Listed next is the program from above. It drew a line 10 squares long across the top of your screen.

```
 10 CLS
 20 FOR X=0 TO 9
 30 SET (X,0)
 40 NEXT X
999 GOTO 999
```

To get a line all the way across the top of your screen, you don't want X to stop at 9. You want it to go up to 127. You would need to change line 20 to this:

```
20 FOR X=0 TO 127
```

With this line 20, the computer would SET all the lights from (0,0) to (127,0). That's the whole top line. Put the program into your computer. Use the second line 20. RUN and you will see your computer SET all the lights in the top line of your screen.

EXERCISE 8-2: ANOTHER LONG LINE

Below is the program that drew a line 10 squares long down the side of your screen.

```
ENTER
 10 CLS
 20 FOR X=0 TO 9
 30 SET (0,X)
 40 NEXT X
999 GOTO 999
RUN
```

How would you change line 20 to get a line all the way down the side of your screen? That's all the squares from (0,0) to (0,47). After you have written your line, RUN the program with your line 20 in the computer.

NOTE: take your time with these FOR NEXT EXERCISES.

EXERCISE 8-3: A LINE DOWN THE MIDDLE

A line down the middle of your screen would start at (63,Ø) and would end at (63,47). That means: Start at 63 squares over, Ø squares down, and go to 63 squares over, 47 squares down.

Write a program which will draw a line down the middle of the screen. Use FOR NEXT. The first square will be (63,Ø), then (63,1) (63,2) (63,4) and so on, until you get to (63,47). Take your time on this one. And THINK!

EXERCISE 8-4: A LINE ACROSS THE MIDDLE

A line across the middle of your screen would start at (Ø,23) and would end at (127, 23). That means: Start at Ø squares over, 23 squares down, and go to 127 squares over, 23 squares down.

Write a program which will draw a line across the middle of the screen. Use FOR NEXT. The first square will be (Ø,23), then (1,23) (2,23) (3,23) and so on, until you get to (127,23).

EXERCISE 8-5: CROSSROADS

In the last two EXERCISES you drew some lines. One was down the middle of your screen. The other was across the middle of the screen. CAN YOU PROGRAM YOU COMPUTER TO DRAW THEM BOTH? It will make a crossroads.

Look back at your programs in the last two EXERCISES. Then put them together to make this crossroads program.

EXERCISE 8-6: USING STEP WITH GRAPHICS

STEP can be used when you use FOR NEXT with graphics. Put the program on the page in your computer:

```
ENTER
10 CLS
20 FOR X=0 TO 127
30 SET (X,0)
40 NEXT X
50 GOTO 50

RUN
```

and you will have a line.
Now change line 20 to:

```
20 FOR X=0 TO 127 STEP 5
RUN
```

Now your computer will SET (0,0) (5,0) (10,0) (15,0) and so on — a dotted line. Change line 20 so the computer takes different size STEPs. Make it any size step you want. Try several different numbers. RUN and see what happens to your line.

REVIEW 3

address	*	:
,	CONT	GRAPHICS
=	FOR NEXT	one
over, down	( )	PRINT N
;	SET	(63,23)
STEP	variable	Ø

Find the correct words.

1. _____ means "has the same value" or "equals."
2. _____ PRINTs the value of N.
3. _____ is the value of a variable unless you have told the computer otherwise
4. _____ is a letter(s) which you can assign values to.
5. _____ is the command used to get the computer to do something a certain number of times.
6. _____ tells the computer to continue with the program after you have stopped it with BREAK.
7. _____ is used after FOR to tell what size steps.
8. A_____ is used to put two or more commands on the same line.
9. A_____ lets you PRINT in four columns.
10. A_____ PRINTs on a line until it is full.
11. An_____ is used to multiply on the computer.
12. _____ is the command to turn on a graphics square.
13. _____ is the formula for SET.
14. _____ is turning on lights with SET to make pictures.
15. _____ parentheses.
16. _____ is another name for the location of a graphics square.
17. _____ is the graphics square in the middle of the screen.
18. _____ is the size of STEP your computer takes unless you say otherwise.

ANSWERS TO REVIEW OF LESSON 1:

ENTER	Push this key after ever direct command and program line to place them in the computer's memory.
LIST	Tells the computer to show you a list of its program.
Programming	Telling a computer what to do.
" "	Quotation marks — they are placed at the beginning and at the end of words you want the computer to PRINT.
CLS	Clears the screen.
RUN	Tells the computer to do what you have programmed it to do.
10, 20, 30	The best way to number lines of your program. It makes it easy to add lines in the middle of the program.
←	Back Space Key — it erases letters.
SHIFT	Hold this key down to type the special character shown at the top of another key.
NEW	Erases the old program in the computer.
Commands	Words the computer understands.

ANSWERS TO REVIEW 2:

1. READY
2. Programming
3. NEW
4. ←
5. RUN
6. CLS
7. LIST
8. ENTER
9. " "
10. SHIFT
11. PRINT
12. 10, 20, 30
13. BASIC
14. 20 PRINT
15. SYNTAX ERROR
16. GOTO
17. BREAK
18. Endless Loop
19. SHIFT @
20. END
21. Graphics
22. RUN 70
23. LIST 70-

ANSWERS TO REVIEW 3:

1. =
2. PRINT N
3. Ø
4. Variable
5. FOR NEXT
6. CONT
7. STEP
8. :
9. ,
10. ;
11. *
12. SET
13. Over, Down
14. Graphics
15. ( )
16. Address
17. (63,23)
18. ONE

GLOSSARY : VOLUME I

Backspace Key	Used to erase a wrong letter.
BASIC	The language your computer understands.
BREAK	Key to break an endless loop.
Cassette Tape	Used to SAVE and LOAD computer programs.
CLOAD	Command to load a program on a cassette tape.
CLS	Command to clear the screen.
Colon :	Used to put two or more commands on one program line.
Comma ,	Lets you print in columns on the screen.
CONT	Tells the computer to continue with a program after you stopped it with break.
CSAVE "N"	Command to save a program on a cassette tape.
Cursor □	The blinking square that shows you where you are on a line on the computer screen.
Disk	A circular shape of magnetic material used to SAVE and LOAD computer programs.
END	Tells the computer to stop the program and go back to being ready for your commands.
ENTER	Key that is used to put a command or program line into the computer's memory.
FOR NEXT	Command to get the computer to do something a certain number of times.
GOTO	Sends the computer to a certain line in the program.

Graphics	Making displays with lighted squares to make lines, charts, and pictures.
LIST	Tells the computer to show you the program in its memory.
LOAD "Program Name"	Command to put a program from a disk into a computer.
NEW	Command that erases old programs in the computer's memory.
PRINT	command that tells the computer to print something.
Programming	Telling the computer what to do.
Prompt >	Shows you what line you are on.
RESET	Command to turn off a lighted square in graphics.
RUN	Command that tells the computer to follow the program in its memory.
SAVE "Program Name"	Command to save a program on a disk.
Semicolon ;	Tells the computer to print on the same line until that line is full.
SET	Command to turn on a lighted square in graphics.
SHIFT @	Stops your program when it is in an endless loop. Press any key to continue.
Space Bar	Used to make spaces between letters and words.
STEP	Used with a FOR command — tells the computer what size steps to take.
SYNTAX ERROR (?SN)	The computer prints this on the screen when it is given something it doesn't understand.

SUGGESTED PROGRAMMING PROJECTS

PROJECT 1

Using your knowledge of the PRINT command, create a program that will produce a picture of a house on the screen.

PROJECT 2

Write a program that uses most of the commands you have learned.

PROJECT 3

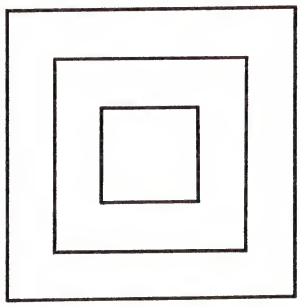
Create a dragon with PRINT commands that will fit on your screen.

PROJECT 4

Can you create a computer program that will list in four columns the even numbers from 2 to 98?

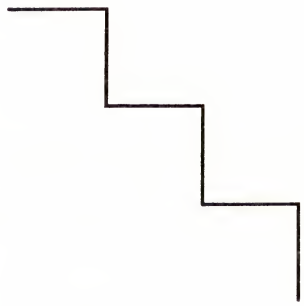
PROJECT 5

Can you write a program that will draw a square bull's eye?



PROJECT 6

```
15 FOR X=12 TO 22
25 SET (X,12)
35 NEXT X
45 FOR Y=12 TO 17
55 SET(22,Y)
65 NEXT Y
75 GOTO 75
```



Can you complete the set of stairs?

Notice where the READY went!
Which line caused it NOT to appear?

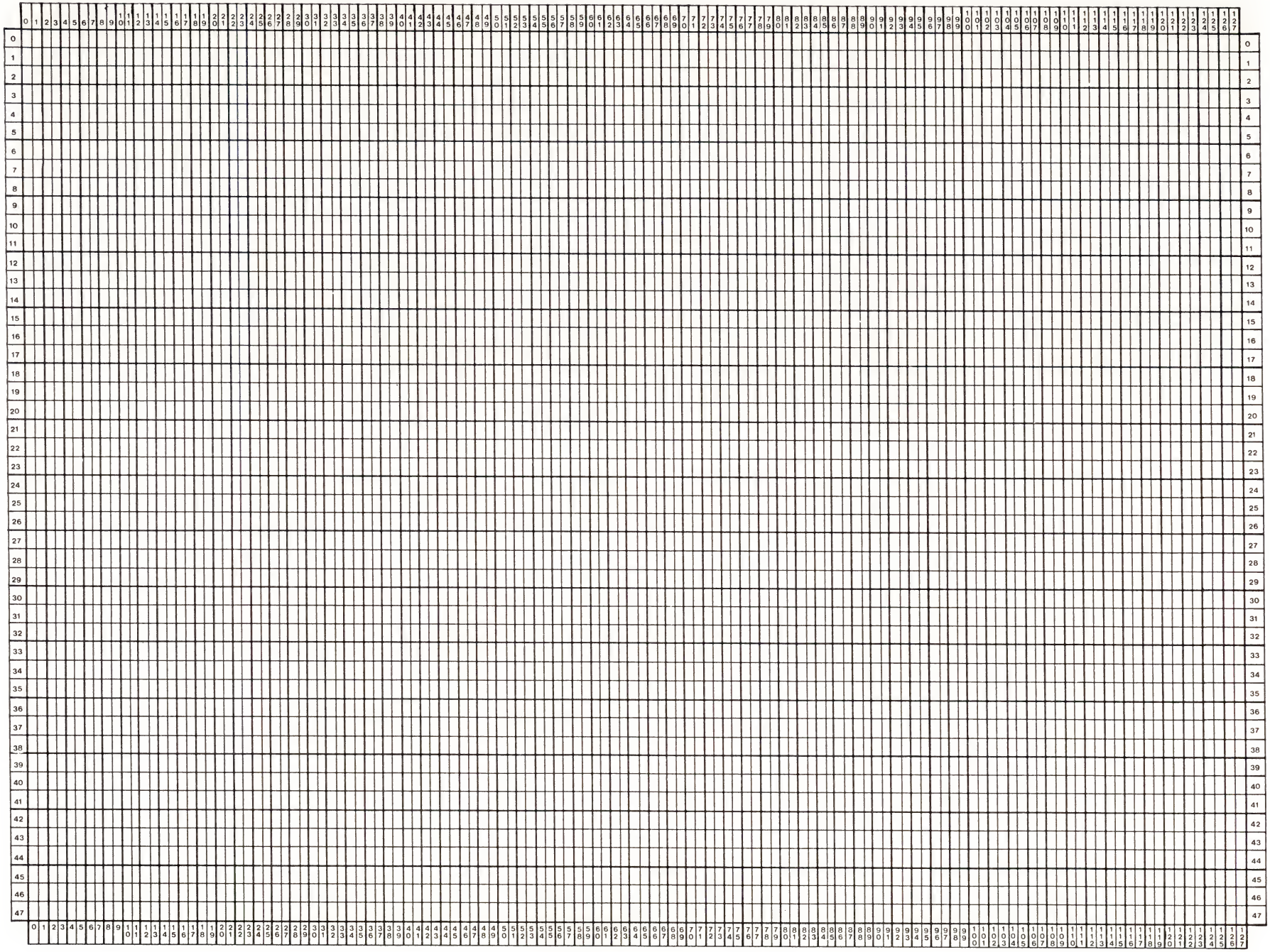
PROJECT 7

Can you write a program that will cause your name to be printed with a box around it? Make the box as decorative as you wish.

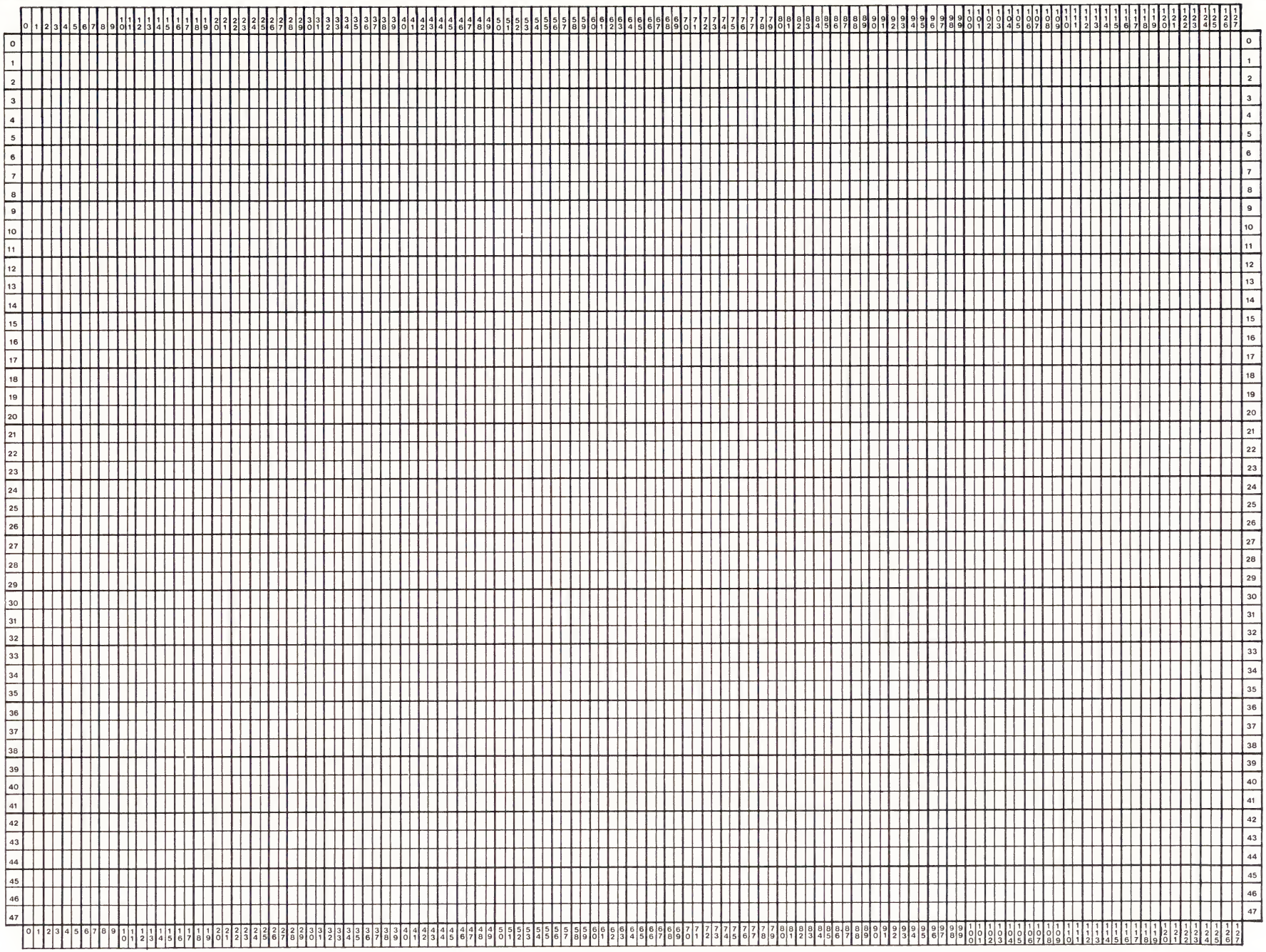
You may wish to save this program so that you can use it at the start of any programs that you write to let people know you CREATED the program.

PROJECT 8

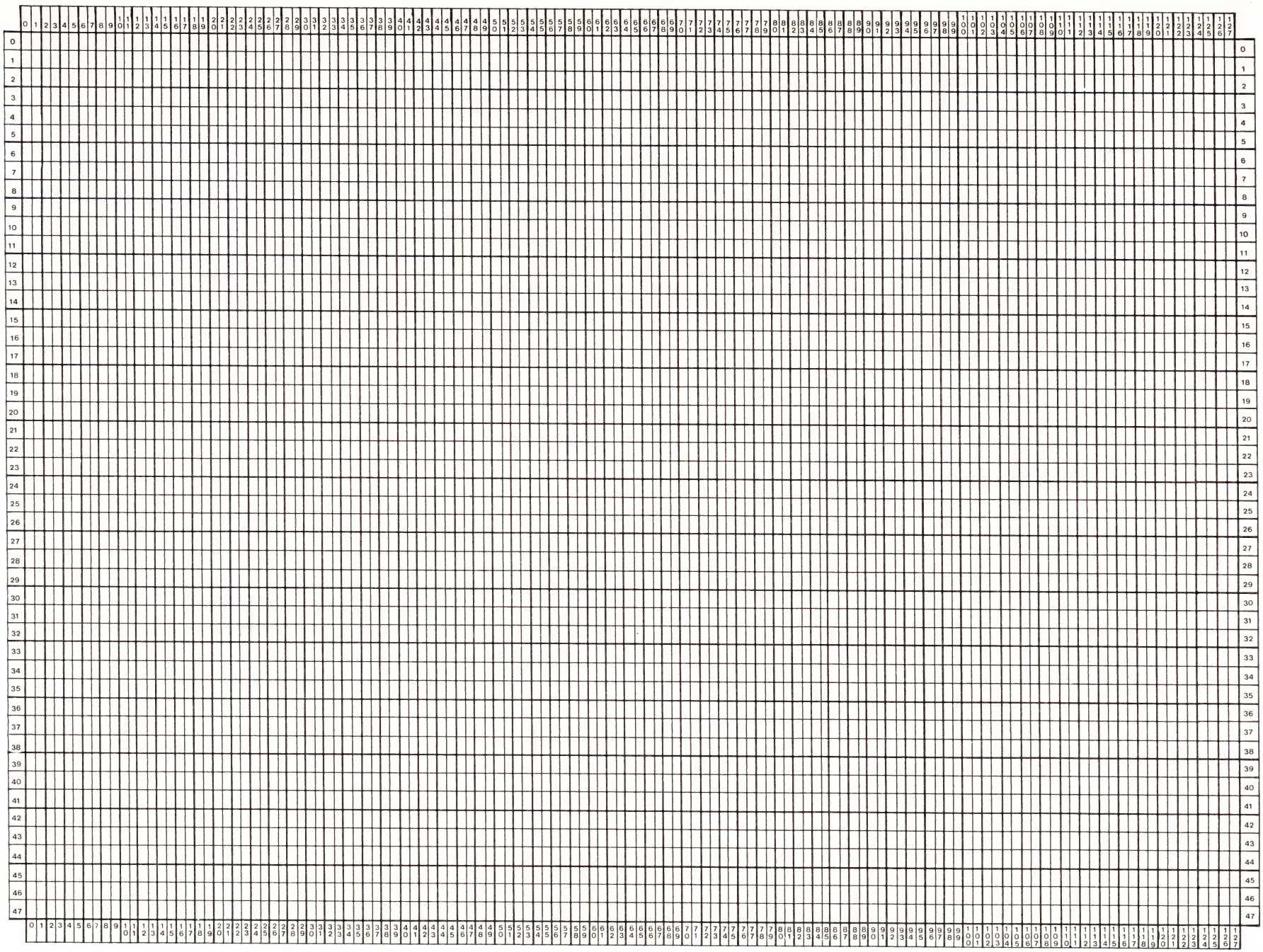
Create a program that will draw a castle on the screen. Make it a good castle with your name somewhere on the castle. SAVE the program.



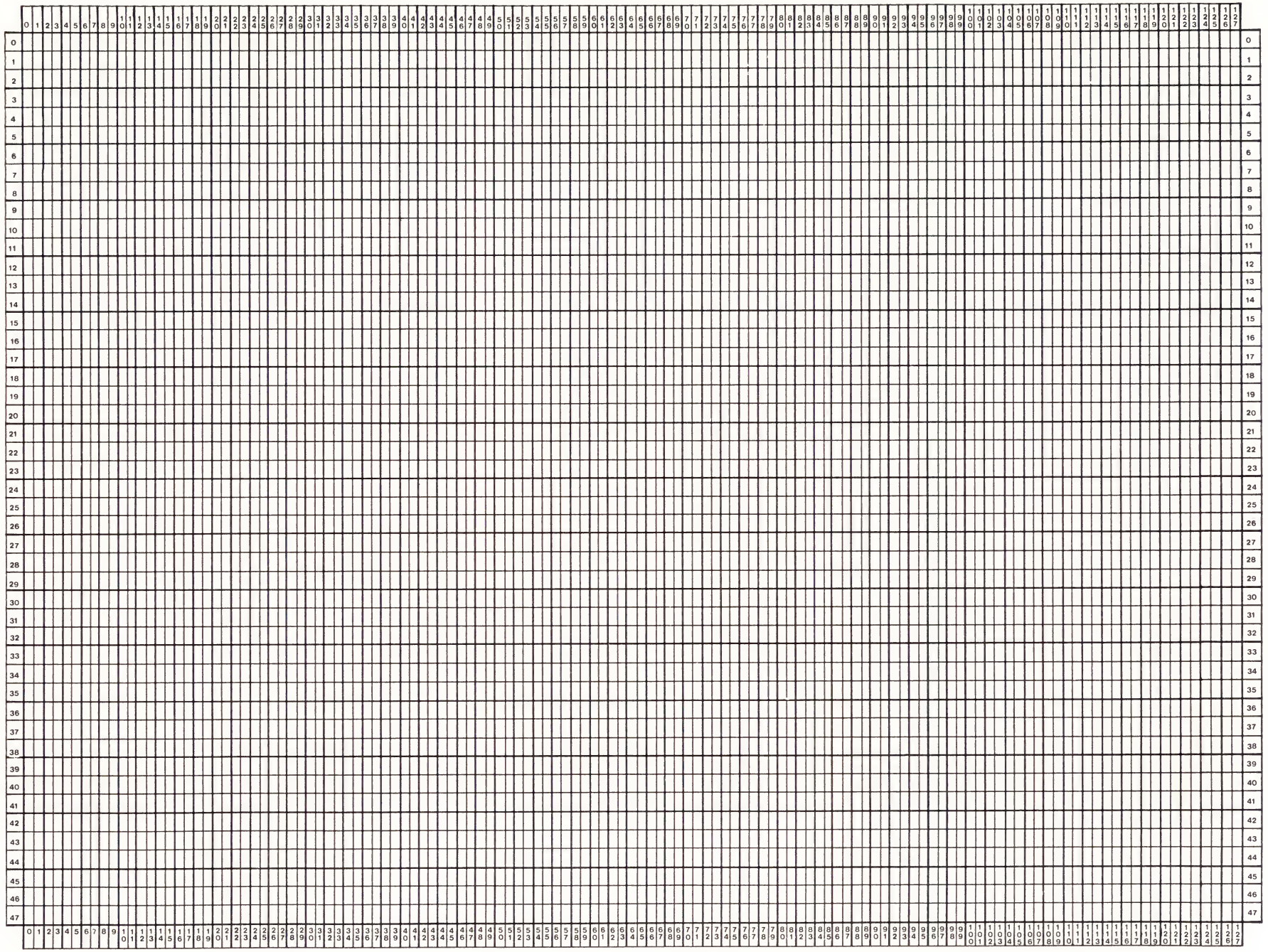
GRAPHICS WORKSHEET



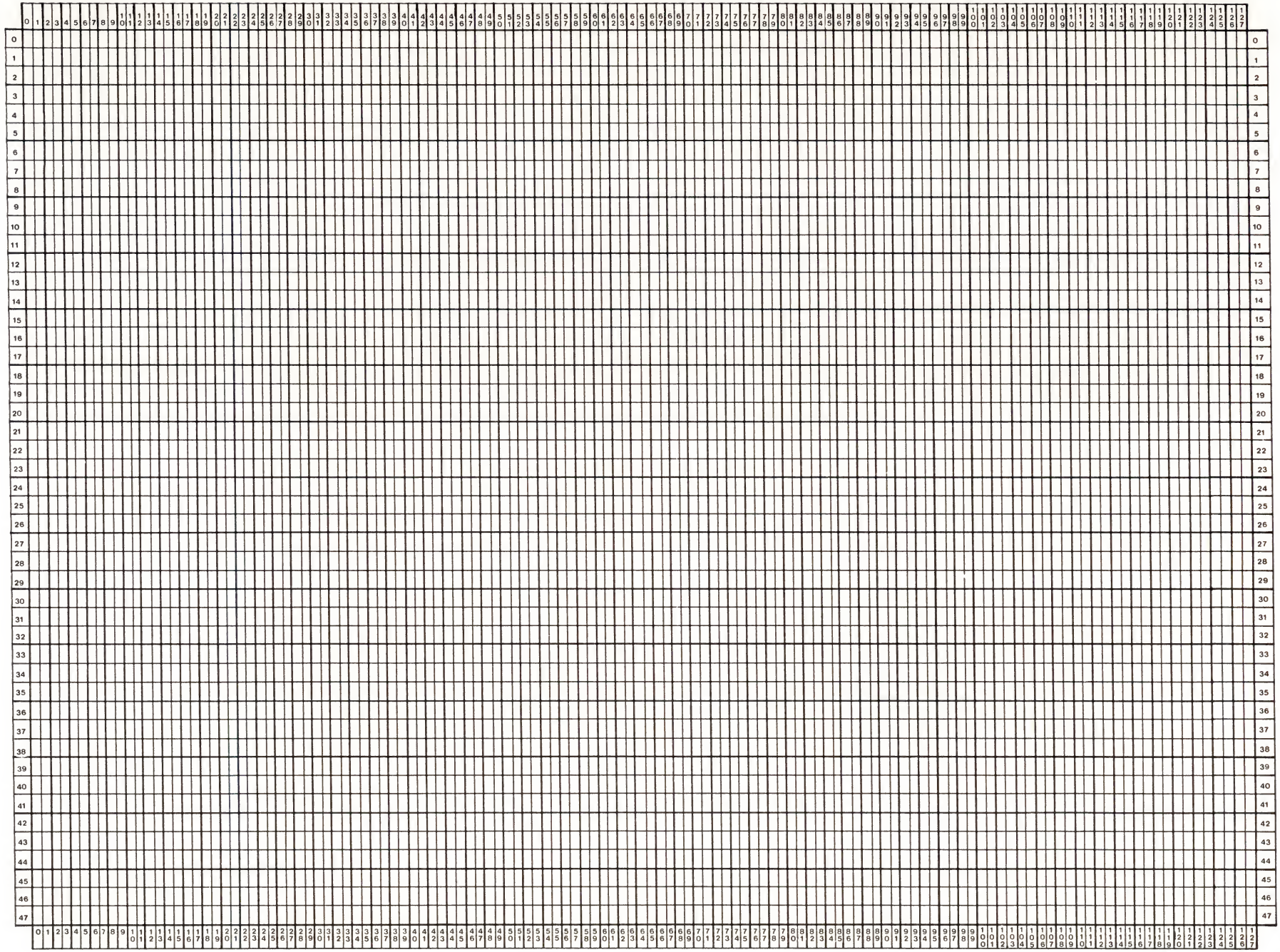
GRAPHICS WORKSHEET



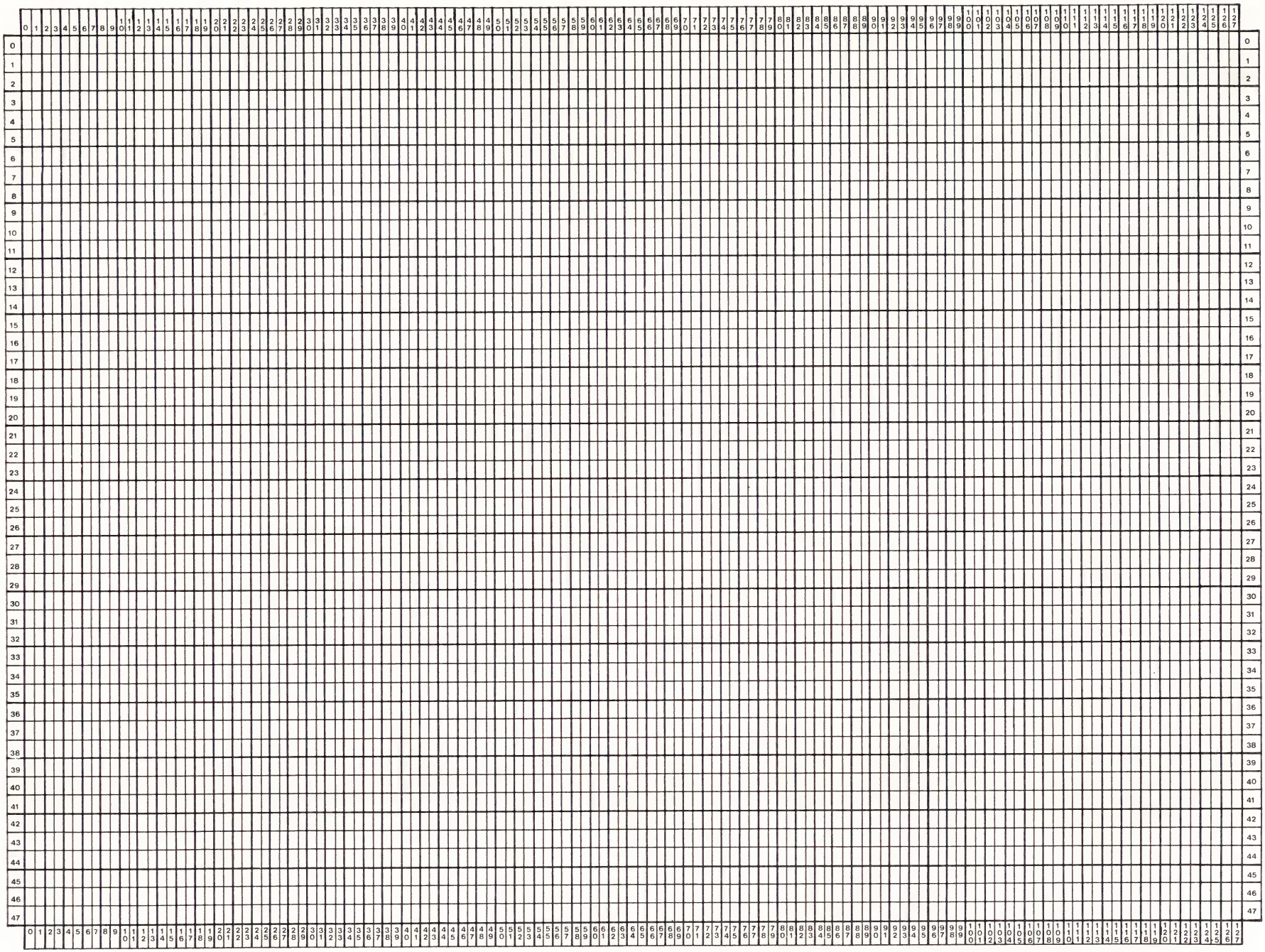
GRAPHICS WORKSHEET



GRAPHICS WORKSHEET



GRAPHICS WORKSHEET



GRAPHICS WORKSHEET

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